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FINAL

Intrinsic Remediation
Engineering Evaluation/Cost Analysis
for UST Site 870

AF CENTER FOR ENVIRONMENTAL EXCELLENCE

Hill Air Force Base
Ogden, Utah

Prepared For

Air Force Center for Environmental Excellence
Technology Transfer Division
Brooks Air Force Base
San Antonio, Texas

and

Hill Air Force Base
Ogden, Utah

June 1995

PARSONS ENGINEERING SCIENCE, INC.

1700 Broadway, Suite 900 • Denver, Colorado 80290 • (303) 831-8100 • Fax: (303) 831-8208

May 22, 1995

Mr. Jerry Hansen
AFCEE/EST
8001 Arnold Drive
Brooks AFB, TX 78235-5357

Subject: Response to Comments on the "Intrinsic Remediation Engineering Evaluation/Cost Analysis for UST Site 870" Hill AFB, Utah

Dear Mr. Hansen:

Parsons Engineering Science, Inc. (Parsons ES, formerly Engineering-Science, Inc.) is pleased to submit this letter in response to comments from Mr. Andrew F. Gemperline of Hill AFB and from Montgomery Watson (comments submitted through Mr. Gemperline).

We found these comments both constructive and informative and look forward to further comments regarding the intrinsic remediation demonstration program. If you have any comments, or if we can be of further assistance, please do not hesitate to call Todd Wiedemeier or Todd Herrington at (303) 831-8100.

Respectfully,

Todd H. Wiedemeier
Project Manager

Todd Herrington

R. Todd Herrington
Project Environmental Engineer

Attachment

cc: Lt. Col. Ross N. Miller, AFCEE
Mr. Douglas Downey, Parsons ES
File 722450.07 Letters

022/722450/101.WW6

PARSONS

EXECUTIVE SUMMARY

This report presents the results of an engineering evaluation/cost analysis (EE/CA) performed by Parsons Engineering Science, Inc. (Parsons ES) [formerly known as Engineering-Science, Inc. (ES)] at Hill Air Force Base, Uta evaluate the use of intrinsic remediation (natural attenuation) with long-term monitoring as a remedial option for dissolved-phase benzene, toluene, ethylbenzene, and xylene (BTEX) contamination in the shallow saturated zone near underground storage tank (UST) Site 870. Soil and ground water contamination is known to occur at the site, with contamination being present in the dissolved and gaseous phases, and as light nonaqueous phase liquid (LNAPL). This study focused on the impact of dissolved-phase BTEX on the shallow ground water system at the site. Site history and the results of soil and ground water investigations conducted previously are also summarized in this report.

An important component of this study was to assess the potential for BTEX dissolved in ground water to migrate from UST Site 870 to potential receptors. The Bioplume II model was used to estimate the rate and direction of dissolved-phase BTEX movement through the shallow saturated zone under the influence of advection, dispersion, , and biodegradation. Input parameters used for the Bioplume II model were obtained from existing site characterization data, supplemented with data collected by Parsons ES in conjunction with personnel from the United States Environmental Protection Agency Robert S. Kerr Environmental Research Laboratory. Chemical analysis of a single LNAPL sample suggests that LNAPL contamination at the site is weathered JP-4 jet fuel. Extensive site-specific data were used as model input. Model input parameters that were not measured at the site were estimated using reasonable literature values for hydrogeologic conditions similar to those found at the site.

The results of this study suggest that dissolved-phase BTEX contamination present in ground water at UST Site 870 poses no significant risk to human health or the environment in its present, or predicted future, concentration and distribution. It is therefore recommended that intrinsic remediation with long-term monitoring be implemented for dissolved-phase BTEX contamination found in ground water at this site. To reduce sources of continuing contamination, it is also recommended that mobile LNAPL recovery operations and bioventing activities currently underway at the site be continued.

To verify Bioplume II model predictions, it is recommended that eight long-term monitoring (LTM) wells, three point-of-compliance (POC) monitoring wells, and a POC sampling location at

I. Response to comments submitted by Mr. Andrew F. Gemperline, Site 870 project manager:

1. **Figure 1.2 Site Map** Suggest the base boundary and major interstate highway be identified on this figure. This document is intended as part of Hill AFB's corrective action plan and will be subject to public review and comment. Identification of major public roads and structures will aid in local citizen's review.

Response: Agree, these changes have been made to Figure 1.2.

2. **P 1-3 Section 1.2** The fifth sentence references the location of former UST 870, however, Figure 1.2, which was referred to in the previous sentence does not identify where UST 870 was. Please include location of former UST, Building 870, Hill Field Elementary, and other predominant surface features that would aid the unfamiliar reader in understanding the site.

Response: Agree, these changes have been made to Figure 1.2.

3. **P1-6 Section 1.2.1.** Delete in fourth sentence the reference to Patriot Hills as consisting of industrial and office facilities associated with mission support services. It is a military residential community.

Response: Agree, the sentence now reads: "The Patriot Hills housing area consists of military residential housing."

4. **P1-6 Section 1.2.1 Second paragraph** Replace the wording, "to optimize the usage and number of storage tanks," with "upgrade the underground storage tank,".

Response: Agree, the sentence now reads: "UST 870.0 was excavated and removed in May 1991 and upgraded with a new double-walled steel UST equipped with leak-detection equipment. The new UST serves the same purpose as UST 870.0."

5. **P2-2 Section 2.1** Reference Figure 1.2 for location of the EPA wells identified in this section. Reference to Figure 1.2 in section 2.2.1 can then be deleted.

Response: We agree that Figure 1.2 should be referenced in Section 2.1. However, Section 2.2.1 references Geoprobe®, storm sewer, and monitoring well locations where groundwater samples were collected, and reference to Figure 1.2 should not be deleted. Therefore, the second sentence in the second paragraph of Section 2.1 now reads: "Phase one occurred during the week of 16 August 1993, and consisted of drilling, soil sampling, and monitoring well installation at EPA-82-A, EPA-82-B, EPA-82-C, EPA-82-D, EPA-82-E, EPA-82-F, EPA-82-H, and EPA-82-I (Figure 1.2)."

6. **P2-3 Section 2.1.2.2** More details as to location of Hill AFB decontamination pad and their collection tanks is required in this section. I believe the location would have been on the north end of the Industrial Waste Treatment Facility (IWTP) on base. Please clarify and describe. Furthermore, on P2-7, the final paragraph of this section probably meant the well completion materials were "not" stored near or in areas which could be affected by these substances.

Response: The first sentence in the second paragraph now reads 'During drilling operations, the drill rig, augers, and any downhole drilling and/or sampling equipment were decontaminated at the northern end of the industrial waste treatment plant (IWTP) at Hill AFB." If you can provide more information on the number and size of the IWTP holding tanks, Parsons ES will incorporate this information into Section 2.1.2.2."

The final paragraph of Section 2.1.2.2 now reads: 'Well completion materials were not stored near or in areas which could be affected by these substances."

7. **P2-10 Section 2.1.2.5** Last sentence should reference the Hill AFB industrial wastewater treatment plant (IWTP). Furthermore, did all the wells produce the 10 well casing volumes and have stable numbers for the parameters stated in this section? If not please indicate those that didn't and give explanation.

Response: The last sentence of Section 2.1.2.5 now reads: "All well development waters were collected in 55-gallon drums and transported to the Hill AFB IWTP for treatment and disposal."

As stated in the document, ten casing volumes were purged from each well, and all parameters listed in Section 2.1.2.5 stabilized.

8. **Section 2 General Comment** Geoprobe is often referred to throughout this section. Please provide detailed description as to what the Geoprobe and its sampling apparatus is. Include diagrams where appropriate.

Response: Agree, a new Figure 2.1 showing the Geoprobe apparatus has been included. In addition, the following text has been added to Section 2.2.3.1: 'The Geoprobe® system is a hydraulically powered percussion/probing machine used to advance sampling tools through unconsolidated soils. This system provides for the rapid collection of ground water (and soil and soil gas if necessary) samples at shallow depths while minimizing the generation of investigation-derived waste materials. Figure 2.1 is a diagram of the Geoprobe® system. The following sections describe the Geoprobe® ground water sample collection methods and decontamination methods for the Geoprobe® system."

9. **P2-9 Section 2.1.2.4.2** Please direct reader to location where Monitoring Well Installation Record form information can be found.

Response: Field copies of the monitoring well installation records have been included in Appendix A and referenced as appropriate in Section 2.1.2.4.2. The first sentence in Section 2.1.2.4.2 now reads: "Upon completion of drilling, a monitoring well casing was installed. Well construction details were noted on a Monitoring Well Installation Record form. This information became part of the permanent field record for the site, and copies of the forms are included in Appendix A."

10. **P2-13 Section 2.2.2.1** Please direct reader to location where the ground water sampling form information can be found.

Response: No deviations from the protocol listed in Section 2.2.2.1 were necessary. Therefore, the last sentence in this section has been removed.

11. **P2-16 Section 2.2.3.2.3** Reference IWTP as stated in comment #7 above.

Response: Agree, the reference now reads: "All purge water was placed in 55-gallon drums and transported to the Hill AFB IWTP for disposal and treatment."

12. **P2-17 Section 2.2.4.1 & 2.2.4.2** Please be more detailed as to how DO was measured (e.g. Flask was continuously filled by peristaltic pump well water while DO meter was submerged.)

Response: Agree, Section 2.2.4.1 now reads: "DO measurements were taken using an Orion® model 840 DO meter. Groundwater was continuously extracted and collected in an erlenmeyer flask using a peristaltic pump. The probe of the DO meter was submerged in the flask to monitor DO concentrations. DO concentrations were recorded after DO readings stabilized, and these readings represent the lowest DO concentration observed."

Section 2.2.4.2 now reads: "Redox potential measurements were taken in a similar manner as DO measurements using an Orion® model 290A redox potential meter. Groundwater was continuously extracted with a peristaltic pump and collected in an erlenmeyer flask. The redox probe was submerged in the flask to take continuous redox measurements. Redox potential measurements were recorded after the readings stabilized, and these readings represent the lowest redox potential observed."

13. **P2-17 Section 2.2.5.1** Please provide the details of what chemical preservatives were used, their amounts, which analytical methods required them, etc. The ability to evaluate the data quality would require this knowledge.

Response: Additional detail on preservation methods has been added, and the section now reads: "The USEPA Mobile Laboratory added any necessary chemical preservatives to sample containers prior to sampling. Soil samples collected for VOC analysis were stored in 40 milliliter (mL) volatile organic analysis (VOA) vials and preserved with 5 mL of acidified water (pH < 2) and 5 mL of methylene chloride. Soil samples collected for TOC measurements were stored at 4 degrees Celsius (°C) in coolers. Ground water samples collected for VOC analysis were stored in 40 mL VOA vials with lead-lined septa and preserved with 4 grams of trisodium phosphate. Ground water samples for all oxidized inorganic compounds, with the exception of nitrate, were stored in 200 mL high-density polyethylene (HDPE) sample containers and stored at 4°C or below. Ground water samples collected for nitrate analysis were stored in 200 mL HDPE sample containers and acidified (pH < 2) with sulfuric acid. All analysis for reduced inorganic species (e.g., ferrous iron, nitrite, and methane) were performed immediately in the field."

14. **P3-1 Section 3.1.2** The stormwater collection pond is designated Pond 5 not Pond 3. Please change in this section and on Figure 3.1.

Response: The referenced storm water collection pond should have read "Pond 5" instead of "Pond 3". The reference to the pond now reads: "There is a stormwater collection pond (Pond 5) located to the southwest of the Patriot Hills Housing Area (Figure 3.1)." The same change was made on Figure 3.1.

15. **Appendix A** Monitoring Well completion diagrams for wells other than EPA-92A, 82B, and 82J were not included in this appendix. Please provide.

Response: Parsons ES records show that completion diagrams for monitoring wells EPA-82-A through EPA-82-J were included in the EE/CA report. Missing well completion diagrams were probably the result of accidental omission during copying. Monitoring well EPA-82-G does not exist and monitoring well EPA-82-K was a temporary Geoprobe® ground water sampling point. Hence, neither EPA designated well has a construction diagram.

16. **Figure 3.5** Section 3.3.3.1 references the gradient between EPA-82-I and CPT-27 as shown in Figure 3.5. It is difficult for the reader to find these points when looking at Figure 3.5. Please clean up Figure 3.5 by placing monitoring point location annotation in visible areas.

Response: Agree that certain well labels are obscured. Monitoring point locations have been clarified in Figure 3.5 revisions.

17. **P3-8 Section 3.3.3.2** Give explanation for the two orders of magnitude difference in hydraulic conductivity between the ES slug test findings and the JMM (1991) findings.

Response: As illustrated in available boring logs from both Parsons ES and JMM, the heterogeneous site stratigraphy is composed of numerous soil types, including moderately sorted, silty fine- to medium-grained sand, medium- to course grained sands, cohesive clayey silts to silty clays, silty clay, and clayey sand. Slug tests were performed by JMM at MW-1, whose screened interval is located in silty sands with a large interval (~4 ft) of clayey sand. The EPA monitoring wells where Parsons ES performed slug tests are screened in predominately fine- to medium grained sands. Based on well screen placement, slug tests performed by Parsons ES would give higher hydraulic conductivity values because they were performed at well location screened in more conductive soils.

The above comments have been included in Section 3.3.3.2 as an additional paragraph that reads: "The average hydraulic conductivity estimated by Parsons ES for the shallow saturated zone is one to two orders of magnitude higher than hydraulic conductivities estimated by JMM (1993b). As illustrated in available boring logs from Parsons ES and JMM, the heterogeneous site stratigraphy is composed of numerous soil types including moderately sorted, silty fine- to medium-grained sand, medium- to course grained sands, cohesive clayey silts to silty clays, silty clay, and clayey sand. Slug tests performed by JMM at MW-1 were influenced by silty sands with a large interval (~4 ft) of clayey sand over the screened interval of the well. The locations selected by ES for slug testing (EPA installed wells) were characterized by predominately fine- to medium-grained sands over the well screen intervals; thus, higher values of hydraulic conductivity were derived because slug tests were conducted in more transmissive soils."

18. **P3-11 Section 3.3.3.5** More specific data about the utility corridor on the north side of Sixth Street should be given to assure the reader that it is an unlikely flow path. Include depth to ground water and anticipated or verified depth of utilities to substantiate the improbability of this corridor as a preferential flow path.

Response: Parsons ES will gladly incorporate any utility corridor data (e.g., survey data) into Section 3.3.3.5 (illustrating the low potential of the utility corridor as a preferential flow route for groundwater) if Hill AFB will provide the necessary information.

19. **P4-1 Section 4.1** Indicate that there were many sources of contamination identified at Site 870 including, leaky piping associated with the UST, surface spills and releases from operations since the 1940s, and a faulty 6" diameter pipe located behind the pump facility Building 870 which has been taken out of use until repairs are made. Delete the last sentence, "All underground pipelines have been replaced with aboveground pipelines to remove this possible source of contamination."

Response: Agree, the last sentence of the first paragraph now reads: "Based on the large quantity of contamination, other potential sources of contamination include: leaky piping associated with the UST, surface spills and releases from operations since the 1940s, and a faulty 6-inch-diameter pipe located behind the pump facility Building 870 (pending repairs)." The final sentence of Section 4.1 has been deleted.

20. **P4-9 Table 4.2** Add note to the bottom of table including what "d" associated with SS870A-03 d means. I believe it is a duplicate of a sample analysis.

Response: Agree, this change has been made to Table 4.2. Please confirm for Parsons ES that "d" does indicate a duplicate sample analysis.

21. **P4-12 Section 4.2.3 & Table 4.3** The sample location designations are confusing to me. Need to clarify where these samples were taken within the boring, e.g. Additionally, no discussion as to the appropriateness of using one sampling point over a 10 acre site, consisting of varying geology, to determine the TOC value for the site is given. Montgomery Watson may have additional TOC or OC information to help substantiate the overall site conditions. Please address.

Response: Sample depth designations have been clarified in Table 4.3. An additional paragraph justifying Parsons ES use of soil TOC data reads: "Soil TOC samples were collected just below the phreatic surface for accurate estimates of TOC in the shallow saturated zone. EPA-82-E was selected as a TOC sampling location because it was located outside of mobile or residual LNAPL contaminated soils (which would compromise TOC readings) and directly downgradient from potential plume migration. As a result, the soil TOC at EPA-82-E is indicative of the potential sorptive potential in the shallow aquifer directly downgradient of anticipated plume migration. The TOC estimate compares favorably with literature values defining TOC contents in relatively clean, sandy soils (0.01 percent TOC)." If MW personnel can supply additional TOC data, they will be taken into consideration.

22. **P4-20 Section 4.3.1** Top line references the period between August 1993 and July 1994. It would be less confusing to state between August 1992 and July 1994 to account for the actual comparison time frame. Additionally, some discussion of the comparability of results of samples taken from CPT and TP locations in the field in 1992, with those taken from monitoring wells August 1993 and July 1994, should be given. I do not believe the comparison of Figure 4.4 with Figure 4.5 is appropriate because of the differing sampling and analysis methods used in obtaining the BTEX results used. We can discuss further, however, the presentation of data with questionable comparability is not wise when presenting an innovative approach to cleanup.

Response: We agree that some confusion exists concerning the description of analytical data that were combined to produce BTEX isopleth maps in Figures 4.4 and 4.5. Additional clarification on the generation of these figures has been added to Section 4.3.1.

We disagree that comparison of different sampling and analysis methods used in obtaining BTEX results is invalid. Great care was taken by EPA chemists to protect the integrity of ground water samples by proper sampling technique (minimizing the formation of headspace gases or turbulence that might cause premature volatilization of BTEX compounds) and sample preservation. The same assumption of appropriate sampling technique was extended to JMM's sampling effort for well locations in 1992.

As long as appropriate QA/QC procedures (e.g., sample preservation, instrument calibration, duplicates, matrix spike analyses) are followed from the time the samples are collected through the time they are analyzed, the use of different analytical methods should not produce incompatible results. Therefore, the comparison of data collected in 1992 (EPA methods SW8020 and SW8015M) with data collected in 1993 and 1994 (RSKOP-124) is appropriate.

In addressing concerns about the compilation of different time periods of BTEX data to construct 1993 and 1994 BTEX plume maps, this is a valid technique because it conservatively estimates the total, potential areal extent and concentrations of the hydrocarbon plume, especially when data sets are incomplete based on the number of sampling points at a certain time period. In realization that upgradient data points were missing from 1992/1993 data sets (and it was known that contamination was present in the source area), monitoring wells MW-01, MW-02, and MW-04 through MW-09 were supplemented with 1992/1993 data for a conservative BTEX plume shape. Regardless of the 1992/1993 (with supplemented 1994) data compilation, BTEX in ground water did not migrate a significant distance downgradient, or expand laterally, as indicated by BTEX concentrations in samples collected from downgradient and peripheral wells.

These previous comments were addressed in Section 4.3.1 by adding or amending the text as follows (in bold): "**To evaluate trends in BTEX loss over the site, data sets from different sampling periods were combined to form BTEX isopleth maps for 1993 and 1994 (described in preceding paragraphs). Although generally not a concern, the various ground water analytical methods used to sample ground water from different site characterization studies (1992 to 1994) were judged for their quantitative comparability. Method RSKOP-124 was used by Parsons ES to quantitate aqueous BTEX concentrations during August 1993 and 1994 sampling events. RSKOP-124 is a dual-column, gas**

chromatography/mass spectrometry (GC/MS) technique that has resolution capabilities that are superior to EPA SW-846 Methods 8020/602, 8015M, and 8240 (used for volatile and semi-volatile organic analysis by JMM in 1992). All analytical techniques used for VOC analysis in the different site characterization studies from 1992 to 1994 had identical, achievable detection limits of 1 µg/L and adequate compound resolution capabilities. Hence, comparison of different ground water data sets is not compromised by underestimation or overestimation of a particular analytical technique. Groundwater extraction and preparation techniques used by JMM in 1992 are not available; however, potential differences in sampling technique were predicted to be minor because ground water sampling techniques are fairly standardized."

'Figure 4.4 is an isopleth map that shows the distribution of total BTEX dissolved in ground water through August 1993. Because this figure was used for Bioplume II model input (to be conservative), the highest total BTEX concentrations observed in ground water between August 1992 and August 1993 were used to prepare this figure. This figure also includes data collected from monitoring wells in the source area north of Sixth Street in December 1993/January 1994 (MW-01, MW-02, and MW-04 through MW-09). **These wells cover a very small area relative to the areal extent of the plume, and in some cases these data represent the only data available for this area. As a result, Figure 4.4 represents the most justifiably conservative representation of the 1993 BTEX plume based on all available data**. BTEX contamination is migrating to the southwest in the direction of ground water flow. During the period through August 1993, the BTEX plume was approximately 1,650 feet long and 750 feet wide at the widest point."

'Figure 4.5 is an isopleth map that shows the distribution of total BTEX dissolved in ground water in July 1994. **Like Figure 4.4, this figure also includes data collected from monitoring wells in the source area in December 1993/January 1994 (MW-01 through MW-09) to illustrate the most justifiably conservative BTEX plume for 1994.** Comparison of Figures 4.4 and 4.5 suggests that a substantial reduction in the areal extent and concentration of the BTEX plume occurred between August 1993 and July 1994. With the exception of total BTEX concentrations in some of the monitoring wells located in the area containing mobile LNAPL (wells MW-05, MW-06, EPA-82-D), dissolved-phase total BTEX concentrations were seen to decline over this period. The increased concentrations in these wells could be the result of a fresh spill in the source area. Figure 4.4 shows that through August 1993, the majority of the dissolved-phase. . ."

23. **P4-20 Section 4.3.1** Provide some discussion as to the comparability of EPA-82-I analytical results in 11/93 to those of 7/94.

Response: Groundwater BTEX levels measured at EPA-82-I in November 1993 were quantitated with a head space analysis, while July 1994 BTEX levels were not. Agree that an analysis discrepancy existed between these two sampling events, and the November 1993 data has been omitted from use in Figure 4.4. Otherwise, Figure 4.4 remains unchanged. Furthermore, references to EPA-82-I data during this time period have been omitted from the text in Section 4.3.1.

24. **Figure 4.4** It appears the southeastern portion of this isopleth is a fabrication without data to support. I feel it unwise to present Figure 4.4 as shown with contour lines for concentrations of 1,000 through 4,000 μg/L between monitoring points such as CPT-36 and MW-10. This portion of Figure 4.4 is a large portion to have decreased, as shown in Figure 4.5 and is not founded on available comparable data. Where isopleth contours are in question due to lack of data, please use a broken line to present the uncertainty of the condition.

Response: We feel that isopleth lines of any sort have an inherent error associated with them because they are interpretations of predicted contaminant concentrations based on observed trends and gradients. Isopleth lines unbounded at an edge by a data point have been dashed in Figures 4.4 and 4.5, and in all other figures in the Hill AFB EE/CA.

25. **Figure 4.6 & Figure 4.7** My guess is that Figure 4.6 presents a wider DO plume than the data used to generate it represents. Neither Figure 4.6 or 4.7 have much DO data to substantiate the contours on the southeast portion of the plume. Remove all symbols associated with Geoprobe sampling, soil boring or monitoring well locations not used in measuring the DO in preparation of these figures to enable a less cluttered look at the data used to prepare these figures. Where no data exist to support the isocontours over a large area, we need to use a broken line and explain the uncertainty of our contour placement. Otherwise, the reader is left believing we sampled extensively and our isopleth is quite accurate, when in reality the isopleth is at best an individual interpretation of the data. Each reader may have a wholly different interpretation of the isopleth configuration if examining the DO points used to produce the figure alone.

Response: The isopleths on the southeast portion of the plume were drawn to honor the data points collected at CPT-23, EPA-82-H, and EPA-82-B. Hence, continuity was maintained between the source area and these wells by using inferred isopleth intervals. As stated in response 24, all isopleths are somewhat subjective interpretations of site data. We feel that the locations of the isopleth lines we used are good representations of the data; however, dashed isopleth lines have been included to illustrate the potential variance of these lines in this area. Points containing no data have been removed from Figures 4.6 and 4.7.

26. **Figure 4.8 & 4.9** I would suggest, as in comment #25, that those points not sampled for the parameter, in this case Nitrate and Nitrite, be removed from each figure to allow the reader to evaluate the interpretation of the isopleth map for him/herself.

Response: Agree, well and CPT locations not sampled have been omitted from Figures 4.8 and 4.9.

27. **General Comment: Figures 4.10 through 4.17** Refer to comment #25. Remove all unnecessary symbols and sampling points not sampled to gain data for preparation of these figures.

Response: Agree, well and CPT locations not sampled have been omitted from Figures 4.10 through 4.17.

28. **P4-33 Section 4.3.24** Provide an explanation as to why there did not appear to be any clear trend between BTEX and sulfate concentrations in August 1993. Why would the data be so erratic or non-comparable?

Response: Considering the numerous interactions between different consortia of bacteria, it is quite possible that the redox reactions for sulfate reduction were not mediated in all locations because the subsurface microorganisms were inhibited in some way. A definitive trend showing site-wide sulfate reduction in the vicinity of greatest hydrocarbon contamination was not evident (Figure 4.12). Depletion of other available electron acceptors likely caused sulfate reduction to become more predominant in 1994.

Pursuant to the above response, the following text was amended in Section 4.3.2.4 (in bold): **"There does not appear to be any clear trend between BTEX and sulfate concentrations downgradient from the source (compare Figure 4.12 to Figure 4.5), near the leading edge of BTEX contamination in August 1993. However, localized sulfate reductions are seen in the source area. Figure 4.13 is an isopleth map showing the distribution of sulfate in ground water in July 1994.** This figure includes data collected from monitoring wells in the source area north of Sixth Street in December 1993/January 1994. These wells cover a small area and these data represent the only data available for this area. Comparison of

Figures 4.5 and 4.13 shows graphically that by July 1994, areas with elevated total BTEX concentrations had depleted sulfate concentrations. This is a strong indication that the rate of anaerobic biodegradation of the BTEX compounds through sulfanogenesis increased from 1993 to 1994. **It is possible that the redox reactions required for sulfate reduction to proceed in the ground water environment in 1993 were not microbially mediated, and that the depletion of other available electron acceptors by 1994 likely increased the importance of sulfate reducing processes."**

29. **P5-2 Section 5.2 Bottom of Final Paragraph** The text states that the isopleth maps for DO and nitrate compounds were superimposed and combined to form a "total" electron acceptor isopleth map. Please provide a figure to show what this would look like. Also, see Montgomery Watson comment #3.

Response: Agree, a superimposed isopleth map for oxygen and nitrate has been included in Section 5. The solute transport model was originally set up to use only dissolved oxygen as an electron acceptor. This model predicted a plume size and shape that extended nearly twice as far as the observed plume in 1994. BTEX biodegradation predictions were grossly underestimated by assuming aerobic biodegradation only. Based on these results, it was clear that dissolved oxygen was not the only electron acceptor being utilized for BTEX biodegradation at the site, and in order to calibrate the solute transport model, it was necessary to include another degradation mechanism. Denitrification processes are the most thermodynamically favorable after aerobic respiration. *Upon incorporating* nitrate into the solute transport model, the predicted plume in 1994 was a better match to the observed data, and Parsons ES was able to calibrate the model.

30. **P5-6 Section 5.4.3** The text states the highest total-dissolved BTEX concentrations obtained from laboratory analytical data for the period through August 1993 was used for model development. Be more specific as to how the Appendix D concentration values were arrived at. My first assumption was that the highest BTEX concentration within a grid would be used in the model, however, some other method of determining the BTEX value for each grid square was used. Please explain in the text.

Response: Agree, additional explanation for generation of the modeled total BTEX plume has been added to Section 5.4.3. Ground water analytical data often were collected in multiple sampling events from 1992 to 1993. A conservative total BTEX isopleth map for 1993 was generated by picking the highest total BTEX concentrations at well locations sampled in 1992 to 1993. This conservative isopleth map was then used in model development by superimposing the model grid over it, and extracting representative total BTEX concentrations for the model based on the isopleth contours that intersected a given model cell. Total BTEX concentrations used in the model, and shown in Appendix D, are an estimated average concentration of all isopleth lines in a model cell. The highest concentrations at the site, per se, were not necessarily used for each model cell because a single point or single isopleth line was not considered representative of total BTEX concentrations over the entire 85' by 110' model cell. This method produced a calibrated model plume in 1993 that closely matched observed data in 1993 (Figure 5.2 vs. Figure 4.4). In fact, the calibrated total BTEX plume is slightly higher in both concentration and extent.

Section 5.4.3 now has the following addition: "The BTEX data from Figure 4.4 were used in model development by superimposing the model grid over the isopleth contours. The total BTEX concentrations used in the model, and shown in Appendix D, are estimated average concentrations of all the isopleth lines intersecting the boundaries within each model cell. The highest concentration isopleth lines were not used for allocating BTEX concentrations to model cells because a single isopleth concentration was not representative of the average total BTEX concentrations over the entire 85-foot by 110-foot model cell. Figure 5.2 shows the distribution of the BTEX plume as calculated by the Bioplume II model for T=0 for all models. Comparison of Figures 4.4 and 5.2 . . . ."

31. **P5-8 Top paragraph** The units used for hydraulic conductivity in this section are in ft/s. Please make the presentation of conductivity values consistent between this section which discusses the model input parameters and the previous sections 3.3.3.2 and Table 3.1. Also, explain whether the Montgomery Watson slug test data was used to develop the range identified in this section. If not please explain. See comment #17.

Response: Agree, hydraulic conductivity values have been changed to consistent units throughout the document. Montgomery Watson slug test data were evaluated before generating a calibrated water table, but it was decided that the higher values of hydraulic conductivity measured by ES (Table 3.1) were more representative of the aquifer matrix through which the contaminant is traveling (described in response #17). Higher hydraulic conductivities also were conservative because plume migration distance increases in proportion to increased hydraulic conductivity.

Section 5.4.4 now has the following addition: "Based on slug tests performed at the site, hydraulic conductivity varies from 1.08×10^{-4} ft/s to 6.08×10^{-4} ft/s. This is within the accepted range for sandy materials (Freeze and Cherry, 1979). Slug test results used for modeling do not reflect slug test data collected by JMM (1993) at MW-1. MW-1 was screened in a soil interval characterized by silty sands with a large interval (~4 ft) of clayey sand. Therefore, slug test data from MW-1 were not considered representative of the fine- to medium-grained sandy soils located around the screened monitoring wells used for Parsons ES slug tests in 1993. The sensitivity of the model to this parameter was evaluated during the sensitivity analysis described in Section 5.6."

32. **P5-9 Section 5.4.5 First Paragraph** The assumption at the bottom of this paragraph appears correct, that the oxygen was utilized first by aerobic bacteria and then anaerobic bacteria consumed nitrate as the next available electron acceptor. This assumption does not appear to have been followed when combining the DO and nitrate concentrations because the only place the nitrate would be effective as an electron acceptor is where the DO is equal to zero. See MW comment #3.

Response: We feel that combining oxygen and nitrate concentrations throughout the model grid was appropriate. Theoretically, nitrate is not used for BTEX biodegradation until all modeled oxygen concentrations are depleted to low concentrations. However, significant nitrate reductions occurred in areas with significant oxygen reductions. These trends support the likelihood that denitrification will consistently occur following depletion of oxygen through aerobic biodegradation in all areas of BTEX contamination. Furthermore, both oxygen and nitrate react instantaneously with BTEX relative to the advective groundwater velocity in the aquifer (Borden and Bedient, 1986; J.T. Wilson, personal communication, 1994). Model simulations would be more accurate if instantaneous BTEX biodegradation mechanisms in the presence of nitrate (via denitrification) and other anaerobic electron acceptors (e.g., ferrous iron, sulfate and carbon dioxide) are incorporated into a ground water model. The utilization of instantaneous aerobic and anaerobic reactions in modeling will be expanded by Bioplume III [anticipated release to be in late 1995 (Rifai, 1995)], which will incorporate the instantaneous aerobic and anaerobic reactions using DO, nitrate, ferrous iron, sulfate, and carbon dioxide.

The following text was added after the first paragraph of Section 5.4.5: "The Bioplume II model was calibrated with DO as the only electron acceptor. The result of using DO as the only electron acceptor was a modeled BTEX plume that extended nearly twice as far (and past the Hill AFB boundary) downgradient than the plume observed in 1994. Based on these results, it was clear that DO is not the only electron acceptor being utilized for BTEX

biodegradation. Successful calibration of the Bioplume II model required the use of nitrate, which is the most thermodynamically favorable electron acceptor following oxygen. Furthermore, decreases in nitrate concentrations from anaerobic biodegradation processes were observed in areas with reduced DO concentrations (compare Figures 4.6 and 4.7 with Figures 4.8 and 4.9, respectively). This strongly suggests both denitrification and aerobic oxidation are important biodegradation mechanisms at the site. Although some localized areas on the fringe of the BTEX plume overestimated the actual rate of denitrification because of background DO concentrations, both aerobic oxygenation and denitrification of BTEX contamination were widely observed in the same areas. Therefore, simulating nitrate concentrations with DO concentrations in the model was not an overgeneralization of site electron acceptor potential (as might initially be presumed), but instead was an improved representation of site conditions. Related modeling initiatives to improve simulations of BTEX biodegradation in ground water systems are being accomplished by incorporating nitrate, and other potential anaerobic electron acceptors (e.g., ferric iron, sulfate, and carbon dioxide) into the model code, specifically within the code of the soon-to-be released Bioplume III ground water model (Rifai, 1995)."

"The loss of DO and nitrate in the Bioplume II model was conceptualized with aerobic bacteria using DO, and then with anaerobic bacteria using nitrate as the next available electron acceptor. This assumption is justified based on the observation that aerobic oxidation and denitrification are important biodegradation mechanisms at the site. Once utilized, DO and nitrate will react instantaneously with BTEX relative to the advective groundwater velocity in the aquifer (Borden and Bedient, 1986; Wilson, 1994)."

Furthermore, the second to last sentence in the fifth paragraph also has been omitted.

33. **P5-11 Section 5.4.7** Because of the high degree of model sensitivity to the reaeration coefficient, a better understanding of why the .003 day^{-1} was used should be given. See MW comment #5.

Response: The reaeration coefficient of 0.003 day^{-1} was originally estimated, based on other documented Bioplume modeling efforts (for example, Rifai *et al.*, 1988). Use of the reaeration coefficient is justified at this site because of the shallow water table and the relatively high DO concentrations observed in site ground water. An anaerobic decay coefficient was not included in the model as a conservative assumption.

First-order biodegradation rate constant estimates for Hill AFB range from approximately 0.010 to 0.032 day^{-1} (Wiedemeier *et al.*, 1995). These estimates are an order of magnitude larger than the reaeration coefficient used in the Hill AFB model and suggest that the total of aerobic and anaerobic biodegradation of compounds is occurring at magnitudes much greater than accounted for. However, biodegradation rate estimates based on field data were unavailable at the time of modeling. First-order biodegradation rates are simulated in the Bioplume II model through either reaeration or anaerobic decay coefficients.

Pursuant to the above response, the following text was amended to Section 5.4.7 as follows (in bold): "**The reaeration coefficient is a first-order decay rate constant used by Bioplume II to simulate the replenishment of oxygen into the ground water by soil gas diffusion and rainwater infiltration. Recent data on first-order biodegradation rate coefficients in groundwater at Hill AFB suggest that biodegradation rates ranged from 0.010 to 0.032 day^{-1} over the center and periphery of the groundwater contaminant plume (Wiedemeier *et al.*, 1994). To be conservative, a first-order biodegradation rate coefficient of 0.003 day^{-1} was used in this model. This rate coefficient** was increased and decreased by one order of magnitude during the sensitivity analyses described in Section 5.6.

34. **P5-14 &15 Section 5.5.2** Comparison of BTEX plume data derived up to August 1993 with that of July 1994 is very uncertain. Uncertainly arises from two primary factors: first, the sampling and analysis techniques are different between the two events, and second, the location of sampling, especially on the periphery of the plume was not consistent. These two factors make for a questionable calibration method described in this section.

Response: We disagree that differences between sampling techniques create a large uncertainty between data taken at two different times (as described in the response to comment #22). Although some wells sampled in 1993 were not re-sampled in 1994, the available data for 1994 are sufficient for describing the BTEX plume shape. Perhaps the greatest confusion arises on the representation of ground water BTEX contamination in 1994. Six monitoring wells at the front of the plume (EPA-82-F, -E, -N, -K, -O, and -H) had nondetectable BTEX concentrations (<1 ppb). Monitoring wells MW-11 and EPA-82-B on the sides of the plume also had nondetectable BTEX concentrations. Considering these peripheral wells, and the 21 other monitoring wells showing ground water BTEX contamination, we feel that an accurate representation of the available data is made by Figure 4.5 (and Figure 4.4), and that the ground water model calibration is accurate. Additional data are always preferable, however such data were not available during the generation of these figures.

Dashed isopleth lines in Figures 4.4 and 4.5 (as previously discussed in comment #24) have been included to show areas of uncertainty; however, the figures shown are the best representation of the available ground water BTEX data, and they are not unduly compromised by either different analytical methods or data interpretation. If a preferred method of data representation can be suggested by the reviewer, Parsons ES would consider using it.

A single sentence referring back to Section 4.3.1 was added, because this issue was justified in that section per the response to comment #22. The sentence has been added after the first sentence of the Section 5.5.2 and reads: "The extent of dissolved-phase BTEX contamination in 1993 and 1994 is described in Section 4.3.1."

35. **P5-27 Section 5.7.3** The reference to Figure 5.13 in the text should indicate that the results are for T=3 years. Then the later discussion of the plume disappearance at T=4 years would be more easily understood. I was a little mixed up expecting the T=4 years model results to be shown in Figure 5.13.

Response: Agree, the following text has been amended to the paragraph in Section 5.7.3 (in bold): "...**Figures 5.13 and 5.14 show the results of this model for 1 and 3 years after the implementation of a 15-percent annual source removal technology**. The initial 1 year prediction of plume migration suggests that the plume would extend as far as Cambridge Street at concentrations of 1 µg/L. **By year 3 (Figure 5.14), the BTEX plume had undergone significant attenuation, including a complete reduction of BTEX contamination in the source area. By year 4, the plume had entirely disappeared. This plume disappearance at year 4 was caused by the reduction of the injection loading rates of modeled BTEX to 55 percent of the original loading rate, which was within the biodegradation capacity of the upgradient, influent electron acceptors and aquifer reaeration.**

36. **P5-21 Section 5.7.1** Please show how the initial 3900 gm of dissolved-phase BTEX contamination was derived at T=0.

Response: This estimate was made by using the Bioplume II model output for "Hill-A" which describes the mass of dissolved-phase contamination for each time step.

The following text has been added after the second sentence in Section 5.7.1: "This estimate was calculated by Bioplume II, which summed all dissolved BTEX contamination over the Hill AFB model domain at time zero."

37. **P6-1 Section 6.1** Last sentence contains a double negative, "no unacceptable". Please reword.

Response: Agree, the sentence now reads: "Rather, this report focuses on the potential use of intrinsic remediation and source reduction technologies to reduce BTEX concentrations within the shallow ground water to levels that pose an acceptable risk to human health or the environment."

38. **P 6-6 Second Paragraph Last Line** Change the word "grade" to "degrade".

Response: Agree, the sentence now reads: "The DO introduced by biosparging can also be utilized effectively to aerobically biodegrade the dissolved contaminant mass."

39. **P6-8 Section 6.2.3.2** At the bottom of the second complete paragraph the report states that other studies conducted at this site have addressed the potential impact of soil gas on residential areas and have determined that these pathways are incomplete. This statement is not true, the vapor exposure assessment below the residential area confirmed a completed pathway for soil gas emanating from the ground water contamination to within 4 feet of the surface. No pathway has been completed into the homes. State only in the report that other studies have addressed the potential impact of soil gas.

Response: Agree, the bottom of the fourth paragraph now reads: "Other studies have addressed the potential of soil gas and have determined that pathways to residential structures are incomplete."

40. **P6-9 Section 6.2.3.3** Write out the full wording of Point of Compliance in the first sentence. The designation of the pond referenced should be Pond 5 not Pond 3. See previous comment #14.

Response: Agree, the first paragraph now reads: "The stormwater drain located along Cambridge Street has been identified as the **point of compliance** (POC) for ground water remedial activities because this appears to be the most likely point of exposure for migrating contamination to impact human or ecological receptors. Migration to and discharge of contaminated shallow ground water into the stormwater system could complete an exposure pathway to human or ecological receptors via dermal contact or possible ingestion. The stormwater drain outfall into **Pond 5** is an accessible and well-defined location for monitoring and for demonstrating compliance with protective ground water quality standards, such as federal MCLs."

41. **P6-9 Section 6.2.3.3 Second paragraph** The goal statement indicating that the remediation goal includes restricting long-term ground water use is incorrect. Restricting ground water use is a means for preventing exposure but in itself is not a goal of Hill AFB. Please reword.

Response: Agree, the remediation goal paragraph has been amended as follows (in bold): "This remedial strategy would be consistent with remediation requirements set forth by the State of Utah. The State recognizes that compliance with

promulgated, single-point remediation goals is not necessary if site-related contamination does not pose a threat to human health or the environment (i.e., the exposure pathway is incomplete). Thus, the magnitude of required remediation in areas that can and will be placed under institutional control is different from the remediation that is required in areas that may be available for unrestricted use. **This means that viable remedial alternatives, which includes long-term restrictions on shallow ground water use, must be able to achieve concentrations that minimize plume migration and expansion and potential human risk associated with ground water contact.** The remediation goal for shallow ground water impacting the Cambridge Street stormwater drain is attainment of federal MCLs for each of the BTEX compounds, as listed in Table 6.1. Although it is unlikely that stormwater would be ingested by humans, this level of long-term protection is appropriate for a residential area."

Furthermore, the fourth paragraph of the second paragraph in Section 6.2.3.3 has been omitted.

4. **P6-10 Top Sentence** This sentence is not necessarily accurate. The soil gas emanating from the contaminated shallow ground water below the residential housing area does have a completed pathway to the surface. However, no human health risk is associated with this completed pathway based upon results of the vapor exposure assessment (VEA). See comment #39.

Response: Agree, changes to the top paragraph on P6-10 now reads (in bold): "In summary, available data indicate that no potential exposure pathway involving shallow ground water is complete under current conditions, **with the exception of soil gas emanating from the ground water to within 4 feet of the surface. The exposure route for soil gas was identified in a vapor exposure assessment performed in other site characterization studies (Gemperline, 1995). Although an exposure pathway to the surface is completed from BTEX contamination volatilizing from ground water, human risk was calculated to be inconsequential. Other than soil gas,** no potential exposure pathway involving shallow ground water will be complete under future land use assumptions provided use of ground water as a potable or industrial source of water is prohibited by institutional controls within and downgradient of the source area to the Cambridge Street stormwater drain. Thus, institutional controls are likely to be a necessary component of any ground water remediation strategy for this site. The required duration of these institutional controls may vary depending on the effectiveness of any remedial technology at reducing contaminant mass and concentrations in the ground water. If federal MCLs are exceeded in the Cambridge Street stormwater discharge, remediation of stormwater will be required to prevent pathway completion."

43. **P6-10 Section 6.2.4** Include the word "of" in the third sentence.

Response: Agree, the sentence now reads: 'Screening was conducted systematically by considering the objectives of the AFCEE intrinsic remediation demonstration, the physiochemical properties of BTEX compounds, and other site-specific characteristics such as. . ."

44. **P6-15 Section 6.2.4** The acronym most commonly used for the industrial waste water treatment plant is (IWTP). Please change the IWWTP to IWTP for consistency with Hill's use of the acronym. See also P6-13 Table 6.2.

Response: Agree, this change has been made.

45. **P6-14 Table 6.2** Please change reference to bioventing system currently operating in source area to read "Pilot test system currently operating in source area."

Response: Agree, this change has been made.

46. **P6-15 Section 6.3.1** Please show how the stated 5% annual reduction in source BTEX using the current LNAPL removal system was derived. Show calculations as to how much LNAPL is theorized to be present, how much BTEX is present, how much is removed each year by the LNAPL removal operations. Also, explain whether a 5% removal rate per year can realistically be maintained for more than a few years or whether the rate would most likely decrease over time.

Response: The following two paragraphs have been added after the second paragraph of Section 6.3.1: "A 5-percent annual LNAPL recovery/reduction was selected as a reasonable removal rate of BTEX concentrations emanating from mobile LNAPL at the site. A 5-percent annual BTEX source recovery/reduction could accomplish this. The most important physical processes contributing to BTEX source weathering are volatilization and dissolution. The dissolution of BTEX compounds from LNAPL is accomplished through interfacial dissolution at the fuel/water interface and dissolution into precipitation that is percolating downward."

"The 5-percent annual BTEX loss was selected for comparison purposes only, and is not intended to reflect an actual rate of BTEX source reduction. On the basis of previous fuel-spill investigations in similar soils at Wurtsmith AFB, BTEX constituents in mobile LNAPL decreased at rates exceeding 70 percent per year through natural weathering (Parsons ES, 1995). Approximately 1,500 gallons of JP-4 released into a shallow, sandy aquifer at Wurtsmith AFB in October 1988 had weathered to low residual-phase concentrations (<150 µg/L) without measurable free-product by June 1991. BTEX compounds in LNAPL are being similarly weathered at UST 870, as seen by a decrease in BTEX concentrations in LNAPL over time (Table 4.1). The LNAPL sample taken from MW-10 exhibited a 70-percent loss of BTEX constituents relative to fresh LNAPL (JP-4). Hence, the partitioning strength of BTEX compounds in LNAPL contamination is diminishing not only from engineered removal (bioslurpers), but also from natural weathering. Regardless of the value used to estimate annual BTEX source reductions, the calibrated model predicts that groundwater will not migrate past the base boundary, with the front of the plume stabilizing near Cambridge Street (assuming current conditions are not compromised with further fuel spills). The BTEX plume is expected to disappear from overwhelming natural attenuation mechanisms once BTEX source concentrations are reduced to approximately 50 percent of their current concentration."

47. **P6-16 Top paragraph** Remove the word "of" from the second to last sentence.

Response: Agree, the sentence now reads: 'Based on model predictions, the BTEX plume will approach the Cambridge Street storm drain in approximately 1 to 4 years at concentrations exceeding 1 µg/L."

48. **P6-17 Sections 6.3.2** Bottom paragraph states that during high-flow conditions in the stormwater drain from heavy precipitation events that a portion of the stormwater would pass over the proposed weir and discharge directly into the pond. Please clarify what is meant by a "portion" of the discharge. What happens to the other portion? Does the portion over the low flow weir get treated by the sparge unit?

Response: Agree, this paragraph has been rewritten as follows: "A low-flow weir would be constructed at the stormwater discharge point to convey stormwater through the sparge tank at rates the system is capable of handling. In the event that stormwater runoff exceeds the capacity of the weir (and the sparge tank system), the excess stormwater will be discharged directly to collection ponds without treatment. Although excess water would not be treated, the anticipated risk of BTEX contamination would be very low due to dilution of the BTEX compounds."

49. **P6-20 Section 6.4.1.1** Change reference from Figure 5.9 in the second paragraph to Figure 7.1.

Response: Agree, this reference in the second paragraph now reads: 'However, the model predicted a potential exceedance of the federal MCL for benzene at the POC wells (Figure 7.1) and. . ."

50. **P6-22 Section 6.4.1.1** The top paragraph states that source removal will continue for 8 years. Did the Bioplume model assume we could remove 5 percent of the source continuously for 8 years? If so, is this a good estimate? Please quantitatively present this in the document. See comment # 46.

Response: In response to comment #46, the following sentence has been added after the first sentence of the last paragraph of Section 6.4.1.1: 'The 8-year time frame is a reasonable source removal goal based on predictions of successful source removal, both engineered and natural, that will approach, or exceed, 5 percent annually (Section 6.3.1)."

51. **P6-23 Section 6.4.2** The discussion of Alternative 2 in this section leads me to believe the storm water treatment system is to be constructed and operated from the outset of the corrective action process. Whereas, section 6.3.2 which describes Alternative 2 gave me the impression that only if monitoring of the storm water drain outfall indicated the BTEX MCLs were exceeded would the treatment system be put in place. Please clarify the intentions of this alternative and assure consistency between these two sections. Also, correct formatting error on page 6-24.

Response: Agree, the following text has been amended in Section 6.4.2.1 (in bold): 'The effectiveness of Alternative 1 is enhanced under Alternative 2 by ensuring that if stormwater becomes contaminated, **an air stripping unit will be installed to treat ground water to levels below federal drinking water MCLs before it is discharged to the stormwater pond. As stated in Section 6.3.2, the use of a stormwater air stripper would be contingent on BTEX concentrations exceeding MCLs at the stormwater discharge point.** Air stripping technologies, including sparging tanks, are proven and reliable systems for reducing BTEX compound concentrations in water by more than 95 percent. The use of a low-flow diversion weir to treat only more concentrated BTEX-contaminated stormwater will reduce the size and complexity of the air stripping system. This alternative also complies with the program goals because intrinsic remediation remains the predominant decontamination method at the site."

The formatting error on page 6-24 has been corrected.

52. **P6-26 Section 6.4.3.1** Last sentence of the second paragraph states, 'based on flux testing at other fuel contaminated sites, vapor migration is not anticipated." Flux chamber sampling at this site has confirmed a pathway for BTEX compounds to the surface exists. Please remove the statement from this report.

Response: Agree, this sentence has been removed.

53. **General Comment: Alternative 3** Same concern as in comment #46, please substantiate what 15% removal quantitatively would mean at this site. Also, due to the results of previous total fluids removal techniques and bioslurping study, coupled with the fact that bioventing within the residential area is not an option based upon site flux testing data, I don't believe a 15% removal rate of the BTEX plume continuously over 4 years is a realistic assumption. Must support the assumption better to use it.

Response: Agree, the following paragraph has been included after the first paragraph of Section 6.4.3.1 and reads as follows: 'Conceptually, this 15-percent annual reduction in a BTEX source from mobile LNAPL will be obtained from both natural weathering and increased engineered removal. Natural weathering rates of BTEX compounds in mobile LNAPL under similar conditions can be substantial (Section 6.3.1). Similar weathering losses of JP-4 contamination are occurring at Site UST 870. The assumed 15-percent annual reduction of BTEX constituents in mobile LNAPL does not necessarily represent actual weathering rates, but show potential LNAPL reduction rates as a result of increased LNAPL removal along with natural weathering. More intensive source removal could help achieve protectiveness approximately 4 years sooner than that under Alternative 1. The model predicts that with more intensive source removal, the BTEX plume will be less concentrated approaching the Cambridge Street stormwater drain, and this exposure pathway may not be completed."

54. **P7-2 Top sentence** Change Pond 3 to Pond 5.

Response: Agree, the reference now reads: 'The second network of ground water monitoring points will consist of three POC wells and a POC sampling point at the Pond 5 outfall of the stormwater drain located along Cambridge Street."

55. **P7-2 Section 7.2.1** CPT-40 is recommended as a LTM monitoring point. There is concern from past experience that data collected from a CPT placed monitoring point is not comparable with a standard monitoring well installed by other methods. Additionally, no explanation as to why this point needs to be monitored is given and I am not sure whether the this point exists any longer or whether it is capable of being sampled. Please address these issues before recommending use to this point.

Response: Agree, the following text has been added (in bold): 'Eight ground water monitoring wells placed upgradient, within, and immediately downgradient of

the existing BTEX contaminant plume will be used to monitor the effectiveness of intrinsic remediation in reducing total contaminant mass and minimizing contaminant migration. Figure 7.1 shows the proposed locations of these wells. One new and four existing monitoring wells (MW-04, MW-05, EPA-82-D and MW-10) will be used as LTM wells to monitor natural attenuation within the anaerobic treatment zone and BTEX concentrations in the source area. **In the event that the MW-04 screen is too shallow to permit collection of accurate ground water data, monitoring well EPA-82-I, MW-01, or MW-14 should be considered as a substitute LTM location.** One new LTM well should be placed within the aerobic treatment zone to monitor natural attenuation within this zone. One new LTM well should be placed downgradient of the BTEX plume. Sampling and analysis of the downgradient LTM well (and the POC wells) will be useful in monitoring changes in ground water chemistry through time and will facilitate early detection of plume migration. Because the velocity of the dissolved-phase BTEX plume is retarded relative to the advective ground water velocity and the velocities of the electron acceptors are not, depleted DO, nitrate, and sulfate concentrations, and elevated ferrous iron and methane concentrations will advance in front of the BTEX plume. Thus, changes in the concentrations of the electron acceptors can be used to provide early warning of BTEX plume encroachment on the LTM and POC wells."

"An existing CPT monitoring point (CPT-40) should be used as an upgradient LTM well. CPT-40 was selected as an upgradient LTM point because it has historically been free of ground water contamination and is suited for monitoring background levels of ground water electron acceptors, pH, and oxidation/reduction potential. The different well diameter of CPT-40 compared to the other proposed LTM wells is not a sampling issue because background levels of ground water parameters are presumed to be uniform throughout the shallow aquifer. In the case that CPT-40 is destroyed or inaccessible, a new LTM well (described in Section 7) well be installed instead."

56. **P7-2 Section 7.2** Last statement infers that any detection of BTEX in the POC wells will trigger further evaluation of remedial options. I thought any detection of BTEX compound concentrations above the MCLs would be the trigger for evaluation of other options. Please clarify.

Response: Agree, the last sentence in Section 7.2 now reads: 'Should BTEX compounds be detected in POC wells above MCLs, other remedial options will be evaluated."

57. **P7-3 Figure 7.1** Eliminate extraneous symbols and sampling points from this figure that do not deal with the monitoring plan being proposed. Change Pond 3 to Pond 5 and include a boundary line for Hill AFB property. Inclusion of street names and the elementary school would be helpful as well.

Response: These changes have been incorporated into Figure 7.1

58. **P7-5 Section 7.3.2** The statement, 'If the data collected at any time during the monitoring period indicate the need for additional remedial activities at the site..." is too broad and undefined. Either eliminate this statement or indicate what data and concentration levels would indicate the need for additional remedial activity.

Response: Agree, the last sentence of Section 7.3.2 now reads: 'If the data collected at any time during the monitoring period indicate the need for additional remedial activities at the site (i.e., if concentrations of BTEX exceed MCLs at POC locations) samplin; frequency should be adjusted accordingly."

59. **General Comment:** Change references to Pond 3 and all figures designating Pond 3 to read Pond 5 throughout the document. See comment #s 57, 40 and 14.

Response: Agree, these changes have been applied globally throughout the document.

60. **General Comment:** In Section 8 and other locations within the document, recommendations are made as to the final preferred actions. It is probably wise to reference the Air Force as making those recommendations rather than the contractor, as the ultimate responsibility for the report and site is the Air Force.

Response: Agree, all recommendations will be referred to as Air Force recommendations.

61. **P7-2 Section 7.2.1** Suggest we not recommend MW-04 as an LTM well. Installation problems caused the well to be screened very shallow below the water table. If seasonal fluctuations in the ground water drop the water table, this well may not be a useful data collection point. I'd recommend EPA-82-I, MW-01 or MW-14.

Response: Water level fluctuations may be a concern in sampling LTM wells; however, EPA-82-I is screened under a shallower interval than MW-04 because it has a shorter screen length. In addition, all the monitoring wells appear to be screened in approximately the same relative interval, suggesting that water table drops may occur in all local wells to the same degree. Based on positioning of MW-4, we recommended the same well for an LTM location.

In response to the above comment, the following text has been added into the first paragraph of Section 7.2.1: 'In the event that MW-04 screen is too shallow to permit an accurate ground water sampling, monitoring well EPA-82-I, MW-01, or MW-14 should be considered as a substitute LTM location."

II. Response to comments submitted by Montgomery Watson(MW):

1. The model does not seem to be conservative overall because the continuing source term and the biodegradation assumptions are not conservative. If the source term is underestimated and the degradation rate is overestimated, the model could predict a much more favorable situation than may exist.

Response: We disagree that the model is not conservative because of the biodegradation assumptions used. The suggestion of lowering the degradation coefficient to a lower value, or even eliminating it, is unjustified considering site data. Section 4 illustrates in detail that numerous electron acceptors such as oxygen, nitrate, sulfate, ferric iron, and carbon dioxide are being utilized to varying degrees at Site UST 870 for the microbial destruction of fuel contaminants. Background DO levels of a least 5 mg/L were reduced to below 1 mg/L in the center of the BTEX plume. Reduction of DO alone provides sufficient evidence that biodegradation is occurring and the use of a biodegradation coefficient is warranted. Without a biodegradation coefficient, the plume would travel practically unrestrained toward downgradient receptors (and extending past the base boundary).

The reaeration coefficient was obtained as described in the response to Air Force comment 33. Hence, it is highly likely considering the amount of biodegradation occurring at the site and the number of electron acceptors used, that the reaeration coefficient has been underestimated. Conservatism of biodegradation assumptions was further assumed by using only DO and nitrate as electron acceptors in the model. Because it is likely that biodegradation of site contaminants is underestimated, it is also likely that more biodegradation is occurring than suggested by the model, making it conservative overall.

2. In your assumptions, the presence of measurable free-phase LNAPL is defined as the source area. Residual LNAPL could also act as a source. A larger source area should be used for a more conservative model.

Response: Residual LNAPL contamination was not included as a potential source in the model because little residual-phase soil contamination exists outside of areas estimated to contain mobile LNAPL. This is illustrated when comparing Figures 4.1 and 4.2 in the model. Residual BTEX concentrations downgradient from the LNAPL are below 50 mg/kg and would not be a substantial source of contamination through partitioning from soil to infiltrating waters. As a safety factor, the calibrated model used higher concentrations of dissolved BTEX in the source than have been observed to further establish a conservative bias to the model. This elevated dissolved BTEX parameter helps to offset the effects of any potential residual-phase contamination that was not accounted for by starting model assumptions.

3. Are the degradation assumptions really as conservative as you suggest? Doesn't denitrification take place only in anaerobic areas, therefore, it should not take place simultaneously with aerobic degradation. By adding the nitrate and oxygen together around the periphery of the plume you may overestimate degradation if the two processes do not occur simultaneously. A more conservative model scenario without nitrate should be added for comparison. Aerobic biodegradation is the only process we are sure is happening on the edges of the plume.

Response: Model simulations using DO as the only electron acceptor were run during initial model calibrations. Results of these simulations predicted plume shapes and concentrations greatly in excess of observed conditions. It became evident during the model calibration that additional biodegradation mechanisms, such as denitrification, are occurring at the site. Inclusion of the effects of denitrification into the ground water model created a better match between observed data and modeled results.

Denitrification was modeled by transforming nitrate concentrations into oxygen equivalent concentrations, as described in Section 5 of the EE/CA. The underlying assumption made was that biodegradation potential was great enough that available oxygen and nitrate concentrations both would be utilized. This assumption is supported by comparisons of Figures 4.6 and 4.7 to Figures 4.8 and 4.9, which qualitatively depict nitrate reductions occurring in the same area of DO reductions. Localized overestimation of biodegradation by including nitrate as an electron acceptor may occur; however, overall, geochemical evidence suggests that denitrification is a predominant process occurring at the site. In modeling, BTEX loss theoretically occurs first through aerobic oxidation. When the oxygen is depleted, nitrate remains to degrade more BTEX through denitrification. This is the biodegradation sequence mimicked in the ground water model.

4. The report should note that the overall assimilative capacity is a best case estimate. The reactions are very specific to geochemical conditions and are not guaranteed to happen. The assimilative capacity calculations were done using the highest observed electron acceptor or metabolic byproduct concentrations. Therefore, it is likely to be an overestimate. For example, degradation by iron reduction is calculated based upon the highest ferrous iron concentrations observed (50.5 mg/L). From Figures 4.10 and 4.11, typical ferrous iron concentrations in the source area are 5-10 mg/L. The assimilative capacity due to denitrification was calculated using a background nitrate concentration of 17 mg/L. This value is very high and doesn't appear to be representative of the background nitrate levels shown on Figures 4.8 and 4.9. A value which represents the average background value should be used.

Response: Assimilative capacity is an estimate of the biodegradation potential of ground water. Hence, this estimate must be based on background concentrations of individual electron acceptors. In the case of ferrous iron, ferrous iron is a reduced species of iron generated after ferric iron is used in iron reduction processes. As stated in section 4.3.2.3, the highest concentration of ferrous iron is indicative of the *potential* for iron reduction because it is formed only under reducing environments (ferrous iron is typically non-existent in aerobic environments). The highest levels of ferrous iron will occur in locations of greatest anaerobic activity, such as in the center of the plume. Therefore, we feel that the ferrous iron content of 50.5 mg/L at MW-02 is representative of the iron-reducing *capacity* of ground water at the site. Assimilative capacity is not connotative of *average degradation potential*. Biodegradation capacity through methanogenesis is predicted through the same means.

In terms of the other electron acceptors, such as nitrate, background concentrations outside of the influence of BTEX biodegradation must be used to show uninfluenced, background electron acceptor concentrations. Otherwise, the assimilative capacity of the ground water cannot accurately be gauged. For these reasons, we feel that substituting average values for maximum background values would not accurately describe the overall ability of ground water to biodegrade compounds through aerobic and anaerobic mechanisms.

5. The document doesn't describe where the reaeration coefficient comes from. It seems high, considering the site is covered with a tight clay layer that is sufficient to keep the contaminant vapors from reaching the residents. A lower or zero reaeration value may be more appropriate and conservative. In any case, the source or rationale for the reaeration value used should be stated in the report.

Response: Please see the response to MW comment #1.

INTRINSIC REMEDIATION

ENGINEERING EVALUATION/COST ANALYSIS

for

UST SITE 870

HILL AIR FORCE BASE

OGDEN, UTAH

June 1995

Prepared for:

AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE
BROOKS AIR FORCE BASE
SAN ANTONIO, TEXAS

AND

HILL AIR FORCE BASE
OGDEN, UTAH

Prepared by:

Engineering-Science, Inc.
1700 Broadway, Suite 900
Denver, Colorado 80290

the mouth of the stormwater drain that runs along Cambridge Street be used to monitor the long-term migration and degradation of the dissolved-phase BTEX plume. Regular sampling and analysis of water from these sampling locations will allow the effectiveness of intrinsic remediation to be monitored and should allow sufficient time to implement hydraulic controls to contain the plume if BTEX is detected at the POC sampling locations. The LTM wells and POC sampling locations should be sampled on a semiannual basis for at least 13 years. If the data collected during this period supports the anticipated effectiveness of intrinsic remediation, the sampling frequency can be reduced to once every year, or eliminated. Ground water samples should be analyzed for the parameters described in Section 7 of this report. If BTEX concentrations in water from the POC sampling locations are found to exceed promulgated maximum contaminant levels, additional corrective actions should be taken to remediate ground water at the site, as described in this report.

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SECTION 1

INTRODUCTION

This report was prepared by Parsons Engineering Science, Inc. (Parsons ES) [formerly known as Engineering Science, Inc. (ES)] and presents the results of an engineering evaluation/cost analysis (EE/CA) conducted to evaluate the use of intrinsic remediation (natural attenuation) with long-term monitoring (LTM) for remediation of fuel-hydrocarbon contamination dissolved in ground water at underground storage tank (UST) Site 870, Hill Air Force Base (AFB), Utah. Previous investigations determined that JP-4 jet fuel had been released into the soil and shallow ground water at the site. The main emphasis of the work described herein was to evaluate the potential for intrinsic degradation mechanisms to reduce dissolved-phase benzene, toluene, ethylbenzene, and xylene (BTEX) concentrations in ground water to levels that are protective of human health and the environment.

1.1 *SCOPE AND OBJECTIVES*

Parsons ES, in conjunction with researchers from the United States Environmental Protection Agency (USEPA) Robert S. Kerr Environmental Research Laboratory (RSKERL), was retained by the United States Air Force Center for Environmental Excellence (AFCEE) to conduct site characterization and ground water modeling in support of intrinsic remediation with LTM at UST Site 870.

The scope of work for this project included the following tasks:

- Reviewing existing hydrogeologic and soil and ground water quality data for the site;
- Conducting supplemental site characterization activities to determine the nature and extent of soil and ground water contamination and to collect geochemical data to demonstrate the occurrence of intrinsic remediation;
- Developing a conceptual hydrogeologic model of the shallow saturated zone, including the distribution of contaminants and probable contaminant pathways;
- Determining if intrinsic processes of contaminant destruction are occurring in ground water at the site;

- Performing contaminant fate and transport modeling based on site hydrogeologic conditions using the Bioplume II model;
- Evaluating a range of model input parameters to determine the sensitivity of the model to these parameters and to consider several contaminant fate and transport scenarios;
- Determining if naturally-occurring processes are sufficient to minimize BTEX plume expansion so that ground water quality standards can be met at a downgradient point of compliance (POC);
- Conduct a preliminary exposure assessment for receptors potentially exposed to fuel hydrocarbon contamination in ground water;
- Developing remedial action objectives (RAOs) and reviewing available remedial technologies;
- Using the results of modeling to recommend the most appropriate remedial option based on specific effectiveness, implementability, and cost criteria; and
- Providing a LTM plan that includes LTM and POC well locations and a sampling and analysis plan (SAP).

Site characterization methods used to evaluate intrinsic remediation included Geoprobe® sampling of ground water near existing cone penetrometer testing locations, soil borehole drilling, soil sample collection and analysis, monitoring well installation, and sampling and analysis of ground water from newly installed and existing monitoring wells.

Site-specific data were used to develop a fate and transport model for the site using Bioplume II and to conduct a preliminary exposure assessment. The Bioplume II model was used to simulate the movement and degradation of BTEX in the shallow saturated zone under the influence of advection, dispersion, sorption, and biodegradation. As part of the EE/CA, this modeling effort had three primary objectives: 1) to predict the future extent and concentration of a dissolved-phase contaminant plume by modeling the combined effects of advection, dispersion, sorption, and biodegradation; 2) to assess the possible risk to potential downgradient receptors by conducting a preliminary exposure assessment; and 3) to provide technical support for the intrinsic remediation with LTM remedial option at regulatory negotiations, as appropriate.

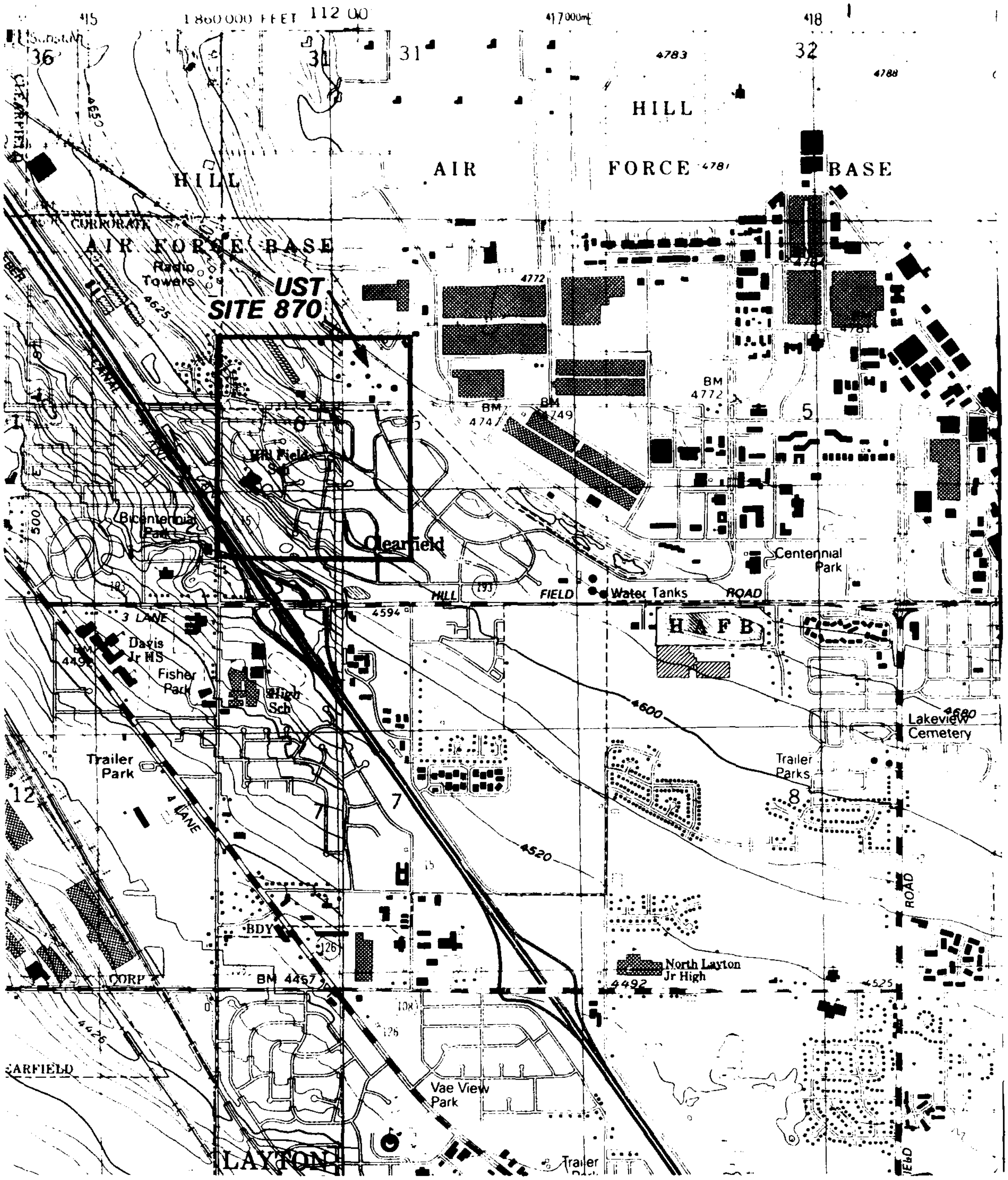
Several remedial options were evaluated as part of this EE/CA, including light nonaqueous-phase liquid (LNAPL) removal; soil vapor extraction; bioventing, hydraulic containment; and intrinsic remediation with LTM. Hydrogeologic and ground water chemical data necessary to evaluate the various remedial options were collected under this program; however, field work was designed to collect the data required by the Bioplume II model and

to support the intrinsic remediation with LTM remedial option for restoration of fuel-hydrocarbon-contaminated ground water.

This report contains nine sections, including this introduction, and five appendices. Section 2 summarizes site characterization activities. Section 3 summarizes the physical characteristics of the study area. Section 4 describes the nature and extent of soil and ground water contamination and the geochemistry of soil and ground water at the site. Section 5 describes the Bioplume II model, the site conceptual model, lists model assumptions and input parameters, and describes sensitivity analyses, model output, and the results of the Bioplume II simulations. Section 6 presents a comparative analysis of remedial alternatives. Section 7 presents the LTM plan for the site. Section 8 presents the conclusions of this investigation and provides recommendations for further work at the site. Section 9 lists the references used to develop this document. Appendix A contains boring logs, monitoring well completion diagrams, and slug test results. Appendix B contains ground water elevation data and information on the seasonal variation in ground water flow at the site. Appendix C presents soil and ground water analytical results. Appendix D contains gridded model input parameters and water table calibration results. Appendix E contains Bioplume II model output on a diskette in ASCII format.

1.2 FACILITY BACKGROUND

Hill AFB is located at 41°07'N latitude, 111°58'W longitude on a bench of the Wasatch Mountains on the edge of the Great Salt Lake Basin. UST Site 870 is located in the southwestern corner of Hill AFB, Utah. Figure 1.1 is a regional location map showing the location of UST Site 870 relative to Hill AFB and the surrounding area. Figure 1.2 is a detailed site map showing UST Site 870 and the immediately adjacent area. UST Site 870 encompasses the area immediately downgradient from and adjacent to the former location of UST 870.0. This site is referred to as Site EGSS by the Utah Division of Environmental Response and Remediation (DERR), and as Site Code ST61 under the Air Force Installation Restoration Program (IRP). For the purposes of the work described herein, UST Site 870 refers to the area shown in Figure 1.2. This area includes the base fuel tank farm which consists of nine aboveground storage tanks (ASTs) used to store JP-4 and diesel fuel. A portion of the Patriot Hills base housing area located southwest of the AST farm, is also included with the site.



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SCALE
1:24,000

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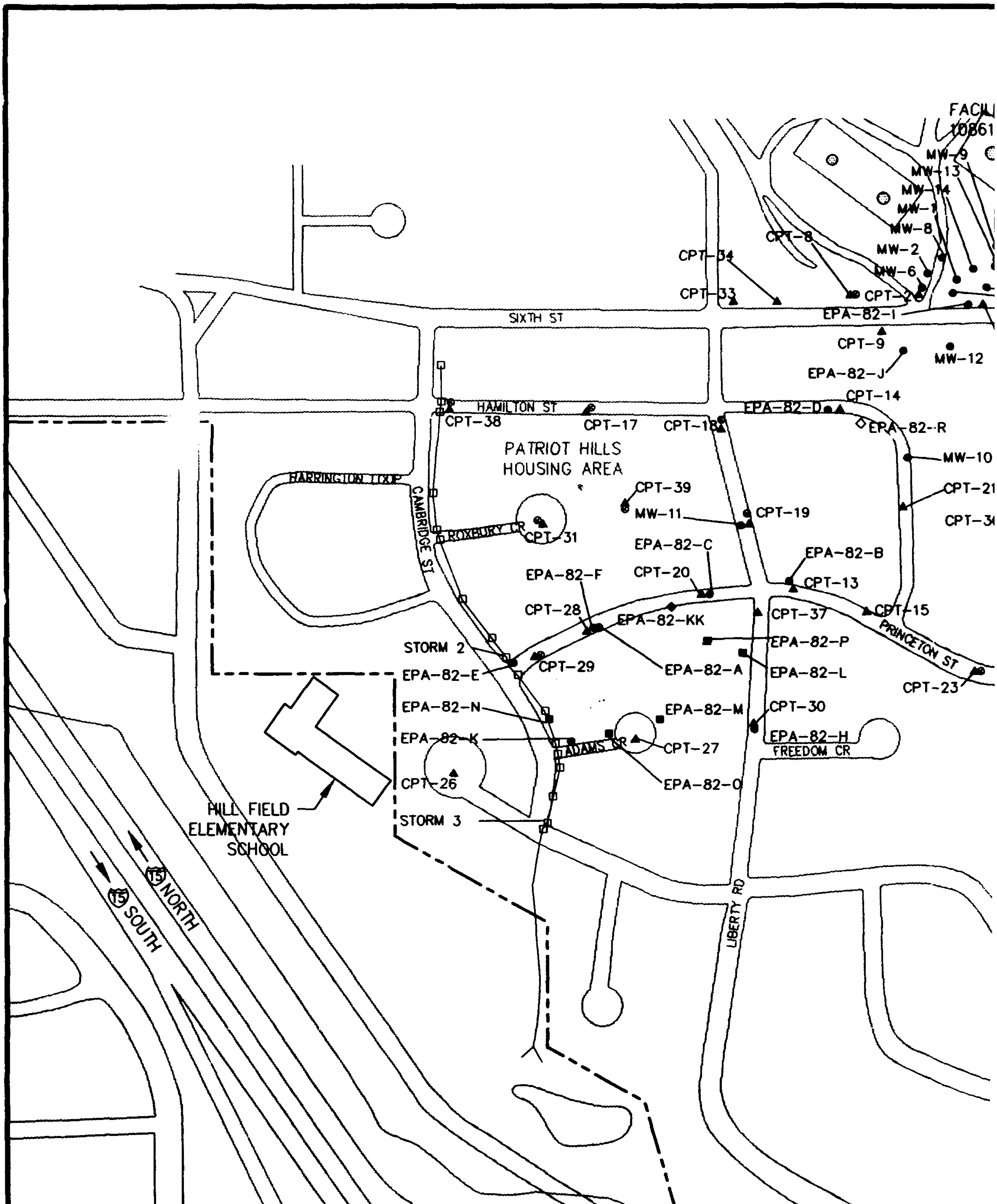
Contour Interval = 5 feet for left 1/3; 40 feet for right 2/3

SOURCE: U.S.G.S. 7.5 Minute Quadrangle Maps: Clearfield, Utah (1991) and Kaysville, Utah (1992) Quadrangles.

FIGURE 1.1
REGIONAL LOCATION MAP

UST Site 870
Intrinsic Remediation EE/CA
Hill Air Force Base, Utah

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado



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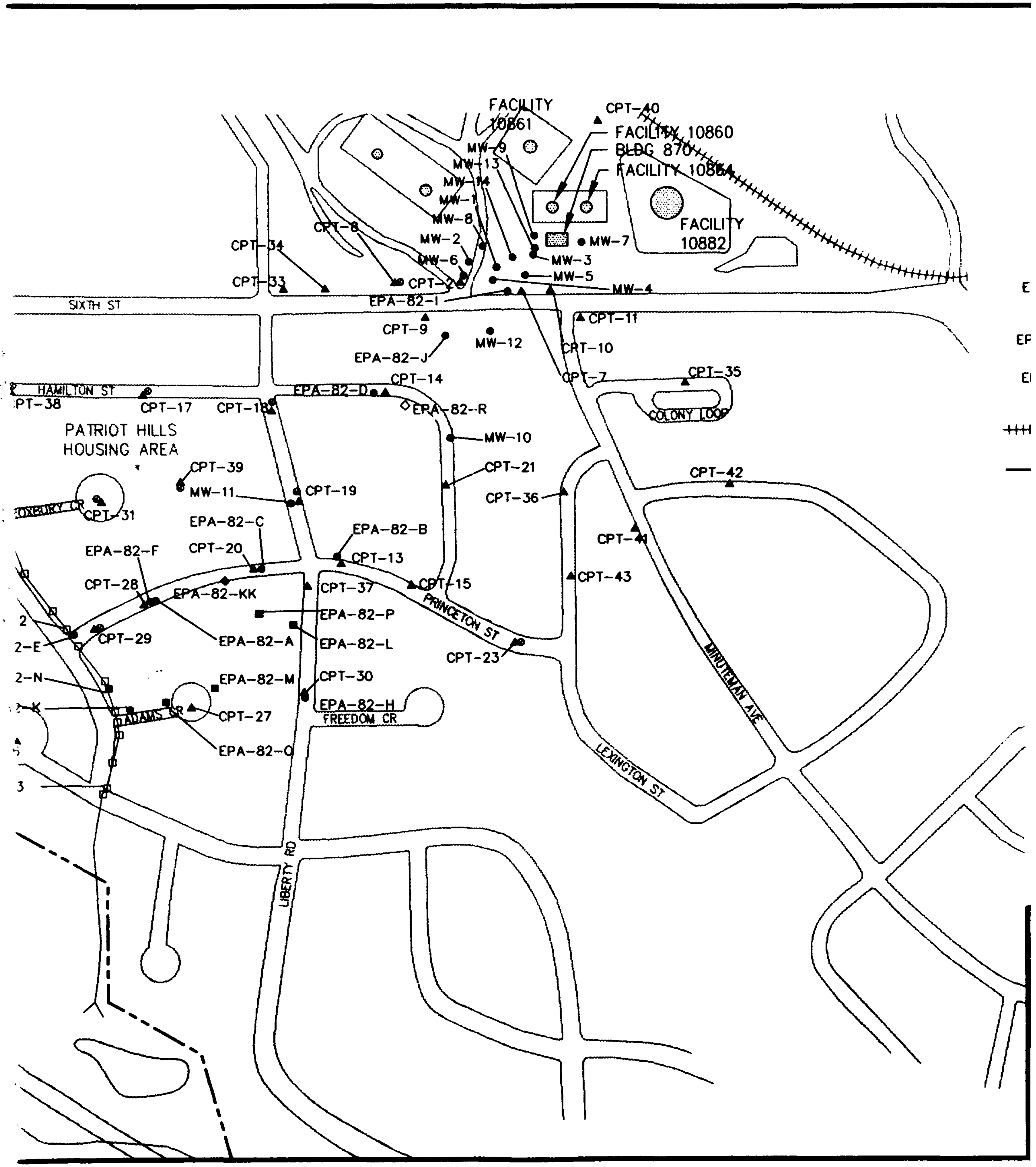

FACILITY 10861
CPT-40
FACILITY 10860
BLDG 870
FACILITY 10864
FACILITY 10882
MW-9
MW-13
MW-14
MW-1
MW-8
MW-2
MW-6
MW-7
MW-3
MW-5
MW-4
CPT-8
CPT-34
CPT-33
CPT-2
EPA-82-I
SIXTH ST
CPT-9
MW-12
CPT-11
CPT-10
EPA-82-J
CPT-7
CPT-35
CPT-14
HAMILTON ST
EPA-82-D
EPA-82-R
COLONY LOOP
PT-38
CPT-17
CPT-18
PATRIOT HILLS
HOUSING AREA
MW-10
CPT-21
CPT-36
CPT-42
CPT-39
MW-11
CPT-19
CPT-31
EPA-82-C
EPA-82-B
CPT-41
EPA-82-F
CPT-20
CPT-13
CPT-43
CPT-28
CPT-37
CPT-15
EPA-82-KK
EPA-82-P
PRINCETON ST
CPT-29
EPA-82-A
EPA-82-L
CPT-23
MINUTEMAN AVE
EPA-82-M
CPT-30
EPA-82-H
FREEDOM CR
ADAMS CR
CPT-27
EPA-82-O
LEXINGTON ST
LIBERTY RD

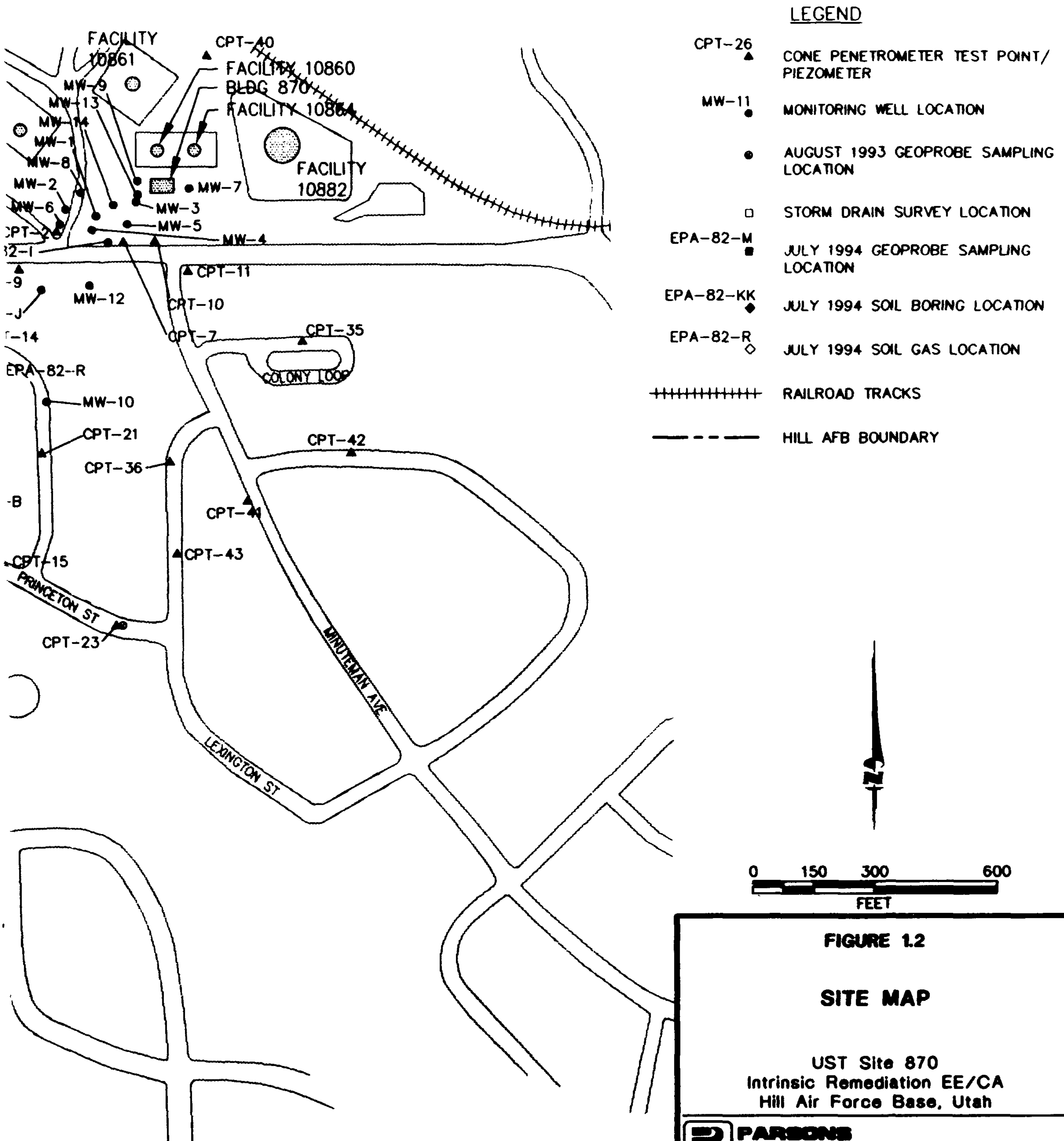

FIGURE 1.2

SITE MAP

UST Site 870
Intrinsic Remediation EE/CA
Hill Air Force Base, Utah

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

1.2.1 Operational History

UST Site 870 is located at one of the base fuel tank farms. This tank farm is bounded on the south by Sixth Street and the Patriot Hills housing area (Figure 1.2). Building 870 at the tank farm serves as the command and logistical support center for the dispensing of JP-4 to the flightlines. Several ASTs are located directly north of Building 870. The Patriot Hills housing area consists of military residential housing. Warehouses, offices, and other large structures are located east and west of the tank farm. Hill Field elementary school is located immediately southwest of the housing area near the base's southwestern property boundary.

UST 870.0 was a 1,000-gallon tank used to store condensate and off-specification JP-4 generated by activities at an adjacent filter stand. UST 870.0 was excavated and removed in May 1991 and upgraded with a new double-walled steel UST that was equipped with leak-detection equipment. The new UST serves the same purpose as UST 870.0.

Soil and ground water contamination was observed during removal of UST 870.0. Several site investigations were conducted by Montgomery-Watson, Inc. (MWI) [formerly James M. Montgomery Consulting Engineers, Inc. (JMM)] in response to this contamination. The results of these investigations are presented in several reports, including:

- Site Characterization Report (JMM, 1991)
- Free Product Letter Report (JMM, 1992a)
- Pumping Tests and Product Thickness Test Letter Report (JMM, 1992b)
- Remedial Options Letter Report (JMM, 1993a)
- Investigation Summary Report (JMM, 1993b)

The site-specific data presented in Sections 3, 4, and 5 are based on a review of these documents and on data collected by Parsons ES and researchers from the RSKERL under this program. A synopsis of site characterization activities conducted prior to implementation of the field work described in this report is provided in the 1993 Investigation Summary Report prepared by JMM (1993b).

1.2.2 Current Remedial Activities

Current remedial activities at UST Site 870 include active and passive light non-aqueous phase liquid (LNAPL) recovery. Active mobile-phase LNAPL recovery is being accomplished

using a QED® specific-gravity skimmer pump installed in a monitoring well and has been conducted since June 1992. Passive LNAPL recovery is also being performed in selected wells by using Soak Ease® absorbent pads enclosed in a stainless steel perforated bailer. To date, about 700 gallons of LNAPL has been recovered using these systems. Water and LNAPL levels are measured monthly to provide information about LNAPL thickness and ground water level fluctuations.

SECTION 2

SITE CHARACTERIZATION ACTIVITIES

To meet the requirements of the intrinsic remediation demonstration, several investigative techniques, including soil and ground water sampling and aquifer testing, were utilized. Soil sampling was accomplished during this investigation using modified hollow-stem auger (HSA) drilling in conjunction with continuous solid-barrel sampling. Previous investigations conducted at the site utilized standard HSA drilling and soil sampling as well as cone penetrometer testing (CPT). Geoprobe® sampling apparatus and newly installed and previously existing monitoring wells were used to collect ground water samples during this investigation. Previous investigations utilized monitoring wells installed in HSA boreholes and monitoring points installed in CPT holes to sample ground water. Aquifer tests conducted at the site included pumping and slug testing.

This section presents the methods used by Parsons ES and researchers from the RSKERL to collect site-specific data at Hill AFB, Utah. Site characterization data obtained under this program were collected in four phases. Phase one consisted of collecting shallow ground water samples using a Geoprobe®. Phase two consisted of continuous soil boring and sampling, ground water monitoring well installation and sampling, and aquifer testing. Phase three consisted of collecting ground water samples from existing monitoring wells. Phase four consisted of continuous soil boring and sampling, ground water monitoring well installation and sampling, and ground water sampling using a Geoprobe®. In addition to the work conducted under this program, MWI collected soil and ground water data on numerous occasions (JMM, 1993b; MWI, MWI, 1994a; MWI, 1994b). Data collected under this program and data collected by MWI were integrated to develop the conceptual site model and to aid interpretation of the physical setting (Section 3) and contaminant distribution (Section 4).

The physical and chemical hydrogeologic data listed below were collected during the field work phase of the EE/CA:

- Depth from measurement datum to the water table or potentiometric surface in monitoring wells and monitoring points;
- Depth from measurement datum to the base of the shallow saturated zone;
- Location of potential ground water recharge and discharge areas;
- Hydraulic conductivity as determined from slug test data;
- Detailed stratigraphic analysis of subsurface media;
- Estimation of extent and thickness of mobile-phase LNAPL;
- Dissolved oxygen, nitrate, ferrous iron, sulfate, methane, chloride, ammonia, and total organic carbon (TOC) concentrations in ground water;
- Temperature, specific conductance, reduction/oxidation (redox) potential, total alkalinity, and pH of ground water;
- BTEX, trimethylbenzene, and total petroleum hydrocarbon (TPH) concentrations in ground water;
- BTEX, trimethylbenzene, and TPH concentrations in soil;
- TOC concentrations in select soil samples; and
- Chemical analysis of free product to determine the mass fraction of BTEX;

The following sections describe the procedures followed when collecting site-specific data. The applied drilling, soil sampling, lithologic logging, and monitoring well development procedures are described in Section 2.1. Ground water sampling procedures are described in Section 2.2. Aquifer testing procedures are described in Section 2.3.

2.1 DRILLING, SOIL SAMPLING, AND MONITORING WELL INSTALLATION

Drilling, soil sampling, and monitoring well installation were accomplished in two phases under this program. Phase one occurred during the week of 16 August 1993, and consisted of drilling, soil sampling, and monitoring well installation at EPA-82-A, EPA-82-B, EPA-82-C, EPA-82-D, EPA-82-E, EPA-82-F, EPA-82-H, and EPA-82-I (Figure 1.2). Phase two occurred during the week of 4 July 1994, and consisted of drilling and soil sampling at EPA-82-J and EPA-82-K, and monitoring well installation at EPA-82-J. Drilling, soil sampling, and monitoring well installation were accomplished using the procedures described in the following sections.

2.1.1 Well Locations and Completion Intervals

Nine new ground water monitoring wells were installed to help characterize the shallow ground water flow system UST Site 870. These wells are identified as EPA-82-A, EPA-82-B, EPA-82-C, EPA-82-D, EPA-82-E, EPA-82-F, EPA-82-H, EPA-82-I, and EPA-82-J. The new monitoring wells were installed in the locations shown on Figure 1.2. The well locations were selected to provide the hydrogeologic data necessary for successful implementation of the Bioplume II model and to support intrinsic remediation. Table 2.1 presents well completion details.

2.1.2 Well Drilling and Installation Procedures

This section describes the procedures used for drilling and installation of new monitoring wells. All new monitoring wells were installed in accordance with general procedures outlined in Section 8.5 of *A Compendium of Superfund Field Methods* (USEPA, 1987).

2.1.2.1 Pre-Drilling Activities

All necessary digging, drilling, and ground water monitoring well installation permits were obtained prior to mobilizing to the field. In addition, all utility lines were located and proposed drilling locations were cleared prior to any drilling activities.

Water used in drilling, equipment cleaning, or grouting were obtained from an onsite potable water supply. Water use approval was verified by contacting the appropriate facility personnel.

2.1.2.2 Equipment Decontamination Procedures

Prior to arriving at the site, and between each drilling location, the drill rig, augers, drilling rods, bits, casing, samplers, tools, and other downhole equipment were decontaminated using a high-pressure, steam/hot water wash. Only potable water was used for decontamination.

During drilling operations, the drill rig, augers, and any downhole drilling and/or sampling equipment were decontaminated at the north end of the industrial waste treatment plant (IWTP) at Hill AFB. Water from the decontamination operations was allowed to collect in

TABLE 2.1
WELL COMPLETION INFORMATION
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

WELL NUMBER	EASTING**	NORTHING***	DATUM* ELEVATION (ft msl)	GROUND ELEVATION (ft msl)	TOTAL DEPTH (ft btoc)	INNER WELL DIAMETER (inches)	SCREEN LENGTH (feet)	DEPTH TO SCREEN TOP (ft btoc)	DEPTH TO SCREEN BASE (ft btoc)	SCREEN ELEVATION TOP (feet)	SCREEN ELEVATION BASE (feet)
PREVIOUSLY EXISTING MONITORING WELLS											
MW-1	2475.32	3841.98	4683.91	4684.24	28.20	4.00	10.00	18.00	28.00	4665.91	4655.91
MW-2	2389.21	3846.24	4684.39	4681.89	27.90	4.00	10.00	15.00	25.00	4669.39	4659.39
MW-3	2533.09	3882.19	4690.67	4688.43	37.24	6.00	20.00	15.00	35.00	4675.67	4655.67
MW-4	2446.70	3798.05	4682.13	4682.56	24.68	6.00	10.00	14.00	24.00	4668.13	4658.13
MW-5	2536.47	3813.49	4686.76	4687.17	27.39	4.00	10.00	17.50	27.50	4669.26	4659.26
MW-6	2389.06	3794.35	4679.03	4679.34	29.34	4.00	10.00	20.00	30.00	4659.03	4649.03
MW-7	2621.27	3900.79	4693.80	4691.85	40.20	4.00	10.00	28.00	38.00	4665.80	4655.80
MW-8	2449.70	3893.96	4688.02	4686.66	29.72	2.00	10.00	20.00	30.00	4668.02	4658.02
MW-9	2529.21	3930.05	4692.09	4689.68	36.65	2.00	20.00	15.00	35.00	4677.09	4657.09
MW-10	2354.84	3397.60	4662.67	4662.95	44.94	6.00	20.50	25.00	45.50	4637.67	4617.17
MW-11	1923.08	3213.91	4637.37	4637.58	45.32	6.00	20.50	25.00	45.50	4612.37	4591.87
MW-12	2457.72	3650.34	4676.87	4677.35	44.80	6.00	20.50	24.50	45.00	4652.37	4631.87
NEWLY INSTALLED MONITORING WELLS											
EPA-82-A	1546.62	2945.10	4606.35	4606.01	30.40	2.00	5.00	25.00	30.00	4581.35	4576.35
EPA-82-B	2062.23	3063.44	4633.28	4632.99	30.45	2.00	10.00	20.05	30.05	4613.23	4603.23
EPA-82-C	1840.49	3035.78	4625.17	4624.92	24.75	2.00	5.00	19.35	24.35	4605.82	4600.82
EPA-82-D	2167.57	3507.69	4655.39	4655.13	29.81	2.00	10.00	19.41	29.41	4635.98	4625.98
EPA-82-E	1345.36	2845.36	4600.13	4599.74	9.32	2.00	5.00	3.92	8.92	4596.21	4591.21
EPA-82-F	1543.19	2943.57	4606.19	4605.89	9.30	2.00	5.00	3.90	8.90	4602.29	4597.29
EPA-82-H	1964.51	2719.71	4610.81	4610.57	24.50	2.00	15.00	9.10	24.10	4601.71	4586.71
EPA-82-I	2520.42	3771.26	4683.08	4682.80	23.25	2.00	5.00	17.85	22.85	4665.23	4660.23
EPA-82-J	2398.75	3645.85	4675.82	4676.17	32.30	2.00	10.00	22.30	32.30	4653.52	4643.52
MW-13	2573.50	3896.74	4689.21	4689.56	35.00	7.25	10.00	10.00	35.00	4679.21	4654.21
MW-14	2548.14	3861.96	4686.21	4686.53	35.00	7.25	10.00	10.00	35.00	4676.21	4651.21
PIEZOMETERS											
CPT-2	NA	NA	NA	NA	27.00	0.50	5.00	22.00	27.00	NA	NA
CPT-3	NA	NA	NA	NA	26.00	0.50	5.00	21.00	26.00	NA	NA
CPT-4	NA	NA	NA	NA	27.60	0.50	5.00	22.60	27.60	NA	NA
CPT-6	NA	NA	NA	NA	24.00	0.50	5.00	19.00	24.00	NA	[illegible]A
CPT-7	2547.88	3772.45	4684.21	4684.37	23.85	0.50	5.00	18.85	23.85	4665.36	4[illegible]

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TABLE 2.1 (Continued)

WELL COMPLETION INFORMATION
UST SITE 870 INTRINSIC REMEDATION EE/CA
HILL AFB, UTAH

WELL NUMBER	EASTING**	NORTHING***	DATUM* ELEVATION (ft msl)	GROUND ELEVATION (ft msl)	TOTAL DEPTH (ft btoc)	INNER WELL DIAMETER (inches)	SCREEN LENGTH (feet)	DEPTH TO SCREEN TOP (ft btoc)	DEPTH TO SCREEN BASE (ft btoc)	SCREEN ELEVATION TOP (feet)	SCREEN ELEVATION BASE (feet)
PIEZOMETERS (Continued)											
CPT-10	2602.28	3772.04	4686.54	4686.80	25.50	0.50	5.00	20.50	25.50	4666.04	4661.04
CPT-11	NA	NA	NA	NA	30.25	0.50	5.00	25.25	30.25	NA	NA
CPT-12	2354.84	3397.60	4662.67	4662.95	NA	0.50	5.00	NA	NA	NA	NA
CPT-13	2062.91	3060.14	4633.21	4633.43	24.00	0.50	5.00	19.00	24.00	4614.21	4609.21
CPT-14	2182.60	3507.60	4655.88	4656.10	28.28	0.50	5.00	23.28	28.28	4632.60	4627.60
CPT-15	2262.51	2985.53	4638.74	4638.92	35.40	0.50	5.00	30.40	35.40	4608.34	4603.34
CPT-17	1528.38	3493.12	4635.28	4635.51	14.41	0.50	5.00	9.41	14.41	4625.87	4620.87
CPT-18	1885.05	3457.77	4641.46	4641.82	15.09	0.50	5.00	10.09	15.09	4631.37	4626.37
CPT-19	1948.46		4636.98	4637.31	33.35	0.50	5.00	28.35	33.35	4608.63	4603.63
CPT-20	1848.28	3037.59	4625.48	4625.69	28.20	0.50	5.00	23.20	28.20	4602.28	4597.28
CPT-21	2349.56	3244.25	4655.91	4656.26	34.15	0.50	5.00	29.15	34.15	4626.76	4621.76
CPT-22	NA	NA	NA	NA	25.35	0.50	5.00	20.35	25.35	NA	NA
CPT-23	2526.12	2835.21	4642.49	4642.69	31.00	0.50	5.00	26.00	31.00	4616.49	4611.49
CPT-25	NA	NA	NA	NA	38.00	0.50	5.00	33.00	38.00	NA	NA
CPT-26	1208.02	2573.01	4591.94	4592.20	12.30	0.50	5.00	7.30	12.30	4584.64	4579.64
CPT-27	1662.55	2660.73	4604.04	4604.32	10.00	0.50	5.00	5.00	10.00	4599.04	4594.04
CPT-28	1538.79	2939.72	4605.62	4605.96	7.77	0.50	5.00	2.77	7.77	4602.85	4597.85
CPT-29	1400.23	2863.23	4600.67	4600.89	7.00	0.50	5.00	2.00	7.00	4598.67	4593.67
CPT-30	1963.38	2711.28	4610.22	4610.48	15.35	0.50	5.00	10.35	15.35	4599.87	4594.87
CPT-31	1418.19	3205.92	4610.88	4611.15	10.35	0.50	5.00	5.35	10.35	4605.53	4600.53
CPT-33	NA	NA	NA	NA	NA	0.50	5.00	NA	NA	NA	NA
CPT-34	NA	NA	NA	NA	21.90	0.50	5.00	16.90	21.90	NA	NA
CPT-36	2670.91	3231.11	4669.78	4670.01	35.00	0.50	5.00	30.00	35.00	4639.78	4634.78
CPT-37	1970.30	2978.15	4625.35	4625.60	27.50	0.50	5.00	22.50	27.50	4602.85	4597.85
CPT-38	1177.69	3504.76	4615.66	4615.90	14.55	0.50	5.00	9.55	14.55	4606.11	4601.11
CPT-40	2758.65	4145.21	4715.46	4715.05	55.33	0.50	20.00	35.33	55.33	4680.13	4660.13
CPT-41	2857.64	3142.16	4675.19	4675.41	40.05	0.50	5.00	35.05	40.05	4640.14	4635.14
CPT-42	3067.32	3238.57	4678.34	4678.49	39.73	0.50	5.00	34.73	39.73	4643.61	4638.61
CPT-43	2683.44	3014.06	4659.74	4660.02	37.60	0.50	5.00	32.60	37.60	4627.14	4622.14
CPT-44	NA	NA	NA	NA	41.00	0.50	5.00	36.00	41.00	NA	NA

TABLE 2.1 (Concluded)

WELL COMPLETION INFORMATION
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

WEL. NUMBER	EASTING**	NORTHING***	DATUM* ELEVATION (ft msl)	GROUND ELEVATION (ft msl)	TOTAL DEPTH (ft btoc)	INNER WELL DIAMETER (inches)	SCREEN LENGTH (feet)	DEPTH TO SCREEN TOP (ft btoc)	DEPTH TO SCREEN BASE (ft btoc)	SCREEN ELEVATION TOP (feet)	SCREEN ELEVATION BASE (feet)
GEOPROBE											
EPA-82-K	1458.62	2656.22	4598.38	4598.38	9.64	0.25	****	9.64	9.64	4588.74	4588.74
EPA-82-L1	-8055.75	2834.32	4614.15	4614.15	18.80	0.25	1.50	17.30	18.80	4596.85	4595.35
EPA-82-L2	-8055.75	2834.32	4614.15	4614.15	21.80	0.25	1.50	20.30	21.80	4593.85	4592.35
EPA-82-L3	-8055.75	2834.32	4614.15	4614.15	24.80	0.25	1.50	23.30	24.80	4590.85	4589.35
EPA-82-M	1700.5	2698.09	4605.01	4605.01	12.00	0.25	****	12.00	12.00	4593.01	4593.01
EPA-82-M duplicate	1700.5	2698.09	4605.01	4605.01	12.00	0.25	****	12.00	12.00	4593.01	4593.01
EPA-82-N	NA	2738.09	4599.81	4599.81	8.00	0.25	****	8.00	8.00	4591.81	4591.81
EPA-82-O	1594.5	2688.82	4602.30	4602.30	9.80	0.25	****	9.80	9.80	4592.50	4592.50
EPA-82-P	1776.37	2865.35	4612.65	4612.65	19.00	0.25	****	19.00	19.00	4593.65	4593.65

* Datum is top of PVC well casing

** For absolute easting coordinates add 1,860,000 to these numbers

*** For absolute northing coordinates add 280,000 to these numbers

**** Sample collected from end of polyethylene tubing

ft btoc = Feet below top of PVC well casing

ft msl = Feet above mean sea level

NA = Data not available

the decontamination pad collection tanks. Precautions were taken to minimize any impact to the area surrounding the decontamination pad that might result from the decontamination operations.

All sampling tools were cleaned onsite prior to use and between each sampling event with a clean water/phosphate-free detergent mix and a clean water rinse. All well completion materials were factory sealed. All decontamination activities were conducted in a manner so that the excess water was controlled and not allowed to flow into any open borehole.

Fuel, lubricants, and other similar substances were handled in a manner consistent with accepted safety procedures and standard operating practices. Well completion materials were not stored near or in areas which could be affected by these substances.

2.1.2.3 Drilling and Soil Sampling

Drilling was accomplished by using the HSA method, modified with a hinged door on the lead auger. The use of the hinged door facilitated collection of representative soil samples over the entire range of contamination. The borings were drilled and continuously sampled to the proposed total depth of the monitoring well. A final borehole diameter of at least 8 inches (with the exception of EPA-82-J, which used a 6-inch boring) was used for the installation of wells with a 2-inch inside-diameter (ID) casing.

Continuous soil samples were obtained using a 3-inch-ID solid-barrel continuous sampling device. Samples were collected continuously over the full depth of the soil borehole. The soil samples collected were removed from the continuous sampler in 0.3-foot intervals and placed in clean glass jars for laboratory analysis. In addition, a portion of the soil sample was placed in a clean glass jar for photoionization detector (PID) headspace measurements for volatile organic compounds (VOCs) and lithologic logging. Representative portions of the soil samples collected for the headspace procedure were quickly transferred to clean glass jars, sealed with aluminum foil, and held for 15 minutes at an ambient temperature of 65 degrees Fahrenheit (°F) or greater. Semiquantitative measurements were made by puncturing the aluminum foil seal with the PID probe and reading the concentration of the headspace gases. The PID relates the concentration of total VOCs in the sample to an isobutylene calibration standard. The PID was also used to monitor the worker breathing zone.

The Parsons ES field hydrogeologist observed drilling and well installation activities, maintained a detailed descriptive log of subsurface materials recovered, and photographed representative samples. Final geologic boring logs are presented in Appendix A. These logs contain:

- Sample interval (top and bottom depth);
- Presence or absence of contamination based on odor, staining, and/or PID readings;
- Soil description, including color, major textural constituents, minor constituents, relative moisture content, plasticity of fines, cohesiveness, grain size, structure or stratification, relative permeability, and any other significant observations; and
- Lithologic contacts with the depth of lithologic contacts and/or significant textural changes recorded to the nearest 0.1 foot (1 inch).

Soils exhibiting petroleum hydrocarbon contamination based on PID screening were drummed and stored onsite during the drilling operations. Upon completion of the drilling activities, two composite samples from the contaminated soil drums were collected and analyzed by USEPA Methods SW8020 and SW8015 modified. Upon receipt of the soil analytical results, these soils were transferred for disposal to E.T. Technologies, Inc. in Salt Lake City, Utah by Hill AFB personnel. Clean soils were handled by Hill AFB personnel who were responsible for the final disposition of these soils.

2.1.2.4 Monitoring Well Installation

Ground water monitoring wells were installed in nine soil borings under this program. Detailed well installation procedures are described in the following paragraphs. Well completion diagrams are included in Appendix A.

2.1.2.4.1 Well Materials Decontamination

Well completion materials were inspected by the field hydrogeologist and determined to be clean and acceptable prior to use. All well completion materials were factory sealed. Pre-packaged sand, bentonite, and Portland® cement were used in well construction, and the bags were inspected for possible external contamination before use. Materials that could not be cleaned to the satisfaction of the field hydrogeologist were not used.

2.1.2.4.2 *Well Casing*

Upon completion of drilling, a monitoring well casing was installed. Well construction details were noted on a Monitoring Well Installation Record form. This information became part of the permanent field record for the site and is included in Appendix A.

Blank well casing was constructed of Schedule 40 polyvinyl chloride (PVC) with an ID of 2 inches. All well casing sections were flush-threaded, and glued joints were not used. The casing at each well was fitted with a threaded bottom plug and a top cap constructed of the same type of material as the well casing. The top cap was vented to maintain ambient atmospheric pressure within the well casing.

The field hydrogeologist verified and recorded the boring depth, the lengths of all casing sections, and the depth to the top of all well completion materials placed in the annulus between the casing and borehole wall. All lengths and depths were measured to the nearest 0.1 foot.

2.1.2.4.3 *Well Screen*

Well screens were constructed of flush-threaded, Schedule 40 PVC with an ID of 2 inches. The screens were factory slotted with 0.010-inch openings. Each well was screened so that seasonal fluctuations of the water table can be measured. Except where specified, the entire thickness of the sand interval of the shallow aquifer was screened. The position of the screen was selected by the field hydrogeologist after consideration was given to the geometry and hydraulic characteristics of the stratum in which the wells were screened.

2.1.2.4.4 *Sand Filter Pack*

A graded sand filter was placed around the screened interval from the bottom of the casing to approximately 2 feet above the top of the screen. Number 10-20 Colorado silica sand was used for the sand filter pack.

2.1.2.4.5 *Annular Sealant*

An annular seal of sodium bentonite pellets was placed above the sand pack. The pellet seal was a minimum of 2 feet thick and was hydrated in place with potable water. In wells EPA-82-A, EPA-82-B, EPA-82-C, EPA-82-D, EPA-82-E, EPA-82-F, EPA-82-H, and EPA-

82-I, the pellet seal was overlaid with a Portland® cement/sodium bentonite grout that extends from the top of the pellet seal to approximately 4.5 feet below ground surface (bgs). The Portland® cement/sodium bentonite grout mix consisted of one 94-pound sack of cement and about 5 pounds of bentonite for each 7 gallons of water used. The bentonite content of the grout did not exceed 8 percent by dry weight. In well EPA-82-J, Baroid® 3/8 bentonite chips were placed in the borehole from the top of the sand pack to approximately 4.8 feet bgs. The grout or bentonite chips were overlaid with concrete that extends to the ground surface.

2.1.2.4.6 Flush-Mount Protective Cover

Each monitoring well was completed with an at-grade protective cover. In areas with pavement, the at-grade covers were cemented in place using concrete blended to the existing pavement. All wells were completed with concrete pads that slope gently away from the protective casing to facilitate runoff during precipitation events.

2.1.2.5 Well Development

Before being sampled, newly installed monitoring wells were developed. Well development removes sediment from inside the well casing and flushes fines, cuttings, and drilling fluids from the sand pack and the portion of the formation adjacent to the well screen.

Well development was accomplished using a peristaltic pump. The pump tubing was regularly lowered to the bottom of the well so that fines were agitated and removed from the well in the development water. Development was continued until a minimum of 10 casing volumes of water were removed from the well and the pH, temperature, specific conductivity, dissolved oxygen (DO) concentration, and redox potential of the ground water had stabilized. All well development waters were collected in 55-gallon drums and transported to the Hill AFB IWTP for treatment and disposal.

2.1.2.6 Water Level Measurements

Water levels at all sampled monitoring wells were measured. Measurements were made using an electric water level probe capable of recording to the nearest 1/8 inch (0.01 foot). In addition, water level measurements were made in select piezometers and previously existing monitoring wells at the site.

2.1.2.7 Well Location and Datum Survey

The location and elevation of the new wells were surveyed by a registered surveyor soon after well completion. The horizontal location were measured relative to established Hill AFB coordinates. Horizontal coordinates were measured to the nearest 1 foot. Vertical location of the ground surface adjacent to the well casing and the measurement datum (top of the PVC well casing) were measured relative to a US Geological Survey (USGS) mean sea level datum. The ground surface elevation was measured to the nearest 0.1 foot, and the measurement datum elevation was measured to the nearest 0.01 foot.

2.2 GROUND WATER SAMPLING

This section describes the procedures used for collecting ground water quality samples. In order to maintain a high degree of quality control during this sampling event, the procedures described in the following sections were followed.

Ground water samples were collected in four phases under this program. Phase one occurred during the week of 2 August 1993, and consisted of collecting ground water samples near existing CPT locations using a Geoprobe®. This ground water sampling process is described in Section 2.2.3.1. The second phase of ground water sampling occurred during the week of 16 August 1993, and consisted of collecting ground water samples from monitoring wells and water samples from the stormwater drain. The procedures used to sample ground water monitoring wells are described in Section 2.2.3.2. The third phase of ground water sampling occurred during the week of 8 November 1993, and consisted of sampling ground water monitoring wells. The fourth phase of ground water sampling occurred during the week of 4 July 1994, and consisted of collecting ground water samples from monitoring wells and by using a Geoprobe®. In addition to the sampling events conducted under this program, several ground water sampling events have been conducted by MWI at this site.

Activities that occurred during ground water sampling are summarized below:

- Assembly and preparation of equipment and supplies;
- Inspection of the well integrity (for monitoring well sampling), including
  - Protective cover, cap and lock,
  - External surface seal and pad,
  - Datum reference, and

- Internal surface seal;
- Ground water sampling, including
  - *Water level measurements,*
  - Visual inspection of water,
  - Well casing or Geoprobe® point evacuation, and
  - Sampling;
- Sample preservation and shipment, including
  - Sample preparation,
  - Onsite measurement of physical parameters, and
  - Sample labeling and packing;
- Completion of sampling records;
- Completion of chain-of-custody records; and
- Sample disposition.

Detailed ground water sampling and sample handling procedures that were used are presented in following sections.

2.2.1 Ground Water Sampling Locations

Ground water samples were collected from existing and newly installed monitoring wells, from Geoprobe® ground water sampling equipment, and at accessible locations along the storm sewer.

2.2.1.1 Geoprobe® Sampling Locations

Ground water samples were collected using the Geoprobe® sampling apparatus near nine existing CPT locations (CPT-8, CPT-17, CPT-18, CPT-19, CPT-23, CPT-29, CPT-31, CPT-38, and CPT-39) during the week of 2 August 1994. During the week of 4 July 1994, ground water samples were collected using the Geoprobe® sampling apparatus at points EPA-82-K, EPA-82-L, EPA-82-M, EPA-82-N, EPA-82-O, and EPA-82-P. Geoprobe® sampling locations are shown in Figure 1.2.

2.2.1.2 Monitoring Well Sampling Locations

Nine new monitoring wells were installed in the locations shown on Figure 1.2. After completion of well installation and development activities, these wells were sampled using a peristaltic pump with dedicated polyethylene tubing. Previously existing monitoring wells were also sampled under this program.

2.2.1.3 Storm Sewer Sampling Locations

Water samples were collected from accessible locations along the storm sewer system shown on Figure 1.2. These samples are labeled storm-2 and storm-3.

2.2.2 Preparation for Sampling

All equipment used for sampling was assembled and properly cleaned and calibrated (if required) prior to arriving in the field. In addition, all record keeping materials were gathered prior to leaving the office.

2.2.2.1 Equipment Cleaning

All portions of sampling and test equipment that contacted the sample were thorough' cleaned before use. This equipment included water level probe and cable, lifting line, test equipment for onsite use, and other equipment that contacted the samples. The following cleaning protocol was used:

- Cleaned with potable water and phosphate-free laboratory detergent;
- Rinsed with potable water;
- Rinsed with distilled or deionized water;
- Rinsed with reagent-grade acetone;
- Air dried prior to use.

2.2.2.2 Equipment Calibration

As required, field analytical equipment were calibrated according to the manufacturer's specifications prior to field use. This applied to equipment used for onsite chemical measurements of DO, redox potential, pH, specific conductivity, and temperature.

2.2.3 Sampling Procedures

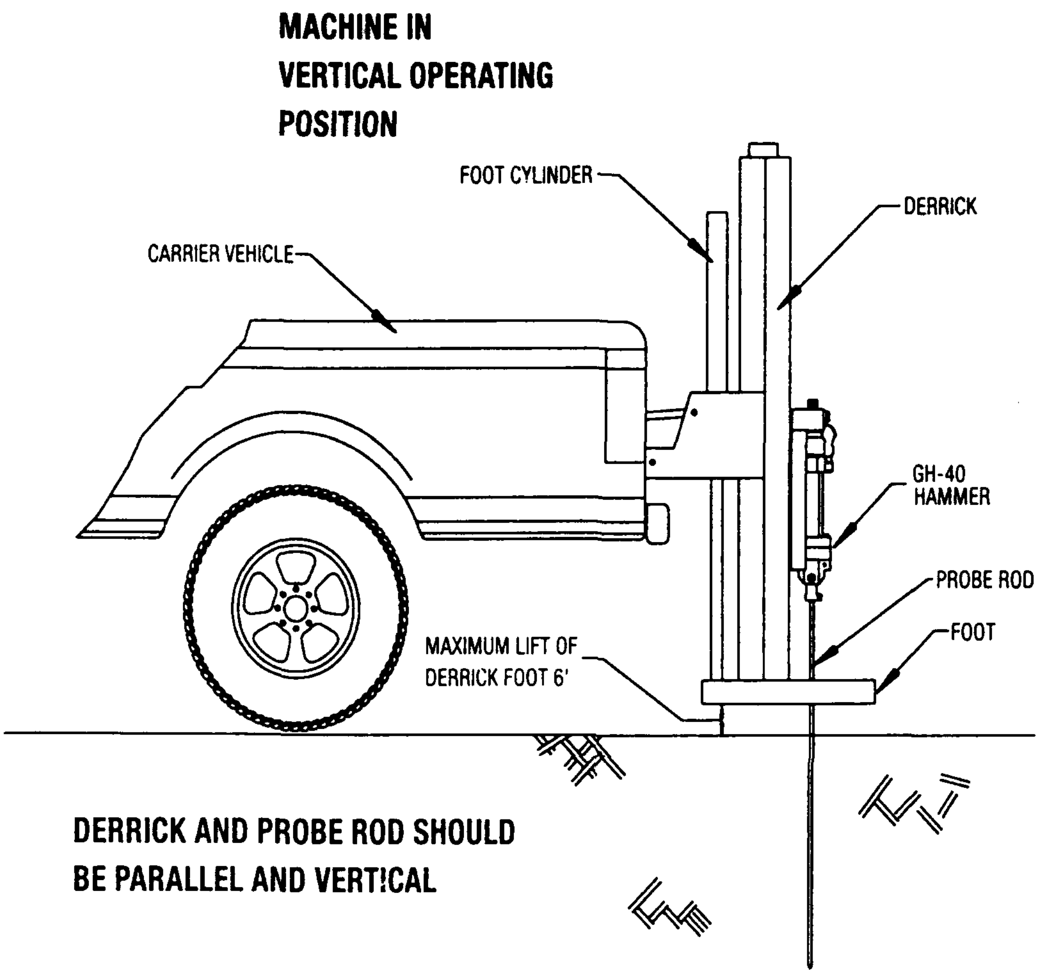
Special care was taken to prevent contamination of the ground water and extracted samples through cross contamination from improperly cleaned equipment. Water level probes and cable used to determine static water levels and well total depths were thoroughly cleaned before and after field use and between uses at different sampling locations according to the procedures presented in Section 2.2.2.1. In addition, a clean pair of new, disposable nitrile gloves was worn each time a different well was sampled.

2.2.3.1 Geoprobe® Ground Water Sampling

The Geoprobe® system is a hydraulically powered percussion/probing machine used to advance sampling tools through unconsolidated soils. This system provides for the rapid collection of ground water (and soil and soil gas if necessary) samples at shallow depths while minimizing the generation of investigation-derived waste materials. Figure 2.1 is a diagram of the Geoprobe® system. The following sections describe the ground water sample collection methods and decontamination methods using the Geoprobe® system.

2.2.3.1.1 Sampling Interval and Method

Based on the anticipated ground water elevation, the sampling depth and interval were estimated prior to driving the Geoprobe® sampling rods into the ground. The Parsons ES field hydrogeologist verified the sampling depth by measuring the length of each Geoprobe® sampling rod prior to insertion into the ground. A disposable drive tip was placed at the tip of the Geoprobe® sampling rods. This tip was threaded on the uphole end to allow attachment of 3/8-inch, high-density polyethylene (HDPE) tubing. After reaching the desired depth, HDPE tubing was threaded through the center of the hollow Geoprobe® sampling rod and secured to the drive point. The tubing was perforated at the downhole end using a 1/16-inch drill bit at 1/4-inch intervals alternately offset at 90 degree angles. The Geoprobe®



Source: Geoprobe Systems®, 1994.

FIGURE 2.1

CROSS-SECTION OF GEOPROBE

UST Site 870
Intrinsic Remediation EE/CA
Hill Air Force Base, Utah

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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sampling rod was then pulled back approximately 1 foot to allow ground water to enter the perforated end of the polyethylene tubing. When the rod was pulled up, the sampling tip remained at the probe termination depth, and the 1-foot perforated interval of the polyethylene tubing was exposed to ground water. Ground water samples were then acquired using a peristaltic pump, as described in Section 2.2.3.1.4

2.2.3.1.2 Preparation of Location

Prior to sampling, the area around the well was cleared of foreign materials, such as brush, rocks, and debris. This prevented sampling equipment from inadvertently contacting foreign materials near the sampling point.

2.2.3.1.3 Water Level and Total Depth Measurements

Prior to removing any water from the Geoprobe® sampling location the static water level was measured. A manometer with hollow HDPE tubing was inserted into the HDPE tubing through which the ground water sample was acquired until positive pressure on the manometer indicated that ground water was reached. The manometer tube was then marked at the level of the ground surface and removed from the ground. Depth to water was determined by placing a tape measure next to the HDPE tubing and measuring the length from the base of the tubing to the ground level mark to the nearest 0.1 foot. Sampling depth was measured to the nearest 0.1 foot by noting the length of each section of Geoprobe®sampling rod placed in the ground.

2.2.3.1.4 Sample Extraction

A peristaltic pump was used to extract ground water samples from the Geoprobe® sampling point. Prior to sample collection, ground water was purged until DO and temperature readings stabilized. The samples were transferred directly to the appropriate sample container. The water was carefully poured down the inner walls of the sample bottle to minimize aeration of the sample.

2.2.3.1.5 Geoprobe® Equipment Decontamination

All geoprobe rids, tips, or other downhole equipment were decontaminated with a high-pressure, steam/hot water wash. Enough linear feet of Geoprobe® rods and Geoprobe® tips

were available that decontamination procedures were minimized to every fourth or fifth Geoprobe® sampling location. Only potable water was used for decontamination. Collection of waters and decontamination of sampling tools is as described in Section 2.1.2.2.

2.2.3.2 Ground Water Monitoring Well Sampling

2.2.3.2.1 Preparation of Location

Prior to starting the sampling procedure, the area around the well was cleared of foreign materials, such as brush, rocks, and debris. These procedures prevented sampling equipment from inadvertently contacting debris around the monitoring well.

2.2.3.2.2 Water Level and Total Depth Measurements

Prior to removing any water from the well the static water level was measured. An electric water level probe was used to measure the depth to ground water below the datum to the nearest 0.01 foot. After measurement of the static water level, the water level probe was lowered to the bottom of the well for measurement of total well depth (recorded to the nearest 0.01 foot). Based on these measurements, the volume of water purged from the wells was calculated.

2.2.3.2.3 Well Bore Purging

Three times the calculated casing volume was removed from each well prior to sampling. All purge water was placed in 55-gallon drums and transported to the Hill AFB IWTP for disposal and treatment. The empty drums were rinsed with hot water and returned to base personnel for reuse. A peristaltic pump with dedicated Teflon®-lined polyethylene tubing was used for well evacuation.

2.2.3.2.4 Sample Extraction

A peristaltic pump with dedicated Teflon®-lined polyethylene tubing was used to extract ground water samples from the well. The sample was transferred directly to the appropriate sample container. The water was carefully poured down the inner walls of the sample bottle to minimize aeration of the sample.

2.2.3.3 Storm Sewer Sampling

A peristaltic pump with dedicated Teflon®-lined polyethylene tubing was used to extract ground water samples from the storm sewer. The sample was transferred directly to the appropriate sample container. The water was carefully poured down the inner walls of the sample bottle to minimize aeration of the sample.

2.2.4 Onsite Chemical Parameter Measurement

2.2.4.1 Dissolved Oxygen Measurements

DO measurements were taken using an Orion® model 840 DO meter. Groundwater was continuously extracted and collected in an erlenmeyer flask using a peristaltic pump. The probe of the DO meter was submerged in the erlenmeyer flask to monitor DO concentrations. DO concentrations were recorded after DO readings stabilized and these readings represent the lowest DO concentration observed.

2.2.4.2 Reduction/Oxidation Potential Measurements

Redox potential measurements were taken in a similar manner as DO measurements using an Orion® model 290A redox potential meter. Groundwater was continuously extracted with a peristaltic pump and collected in an erlenmeyer flask. The redox probe was submerged in the erlenmeyer flask to take continuous redox measurements. Redox potential measurements were recorded after the readings stabilized and these readings represent the lowest redox potential observed.

2.2.4.3 pH, Temperature, and Specific Conductance

Because the pH, temperature, and specific conductance of the ground water change significantly within a short time following sample acquisition, these parameters were measured in the field. The measurements were made in a clean glass container separate from those intended for laboratory analysis, and the measured values were recorded in the ground water sampling record.

2.2.5 Sample Handling

2.2.5.1 Sample Preservation

The USEPA Mobile Laboratory added any necessary chemical preservatives to sample containers prior to sampling. Soil samples collected for VOC analysis were stored in 40 milliliter (mL) volatile organic analysis (VOA) vials and preserved with 5 mL of acidified water (pH < 2) and 5 mL of methylene chloride. Soil samples collected for TOC measurements were stored at 4 degrees Celsius (°C) in coolers. Ground water samples collected for VOC analysis were stored in 40 mL VOA vials with lead lined septa and preserved with 4 grams of trisodium phosphate. Ground water samples for all oxidized inorganic compounds, with the exception of nitrate, were stored in 200 mL high density polyethylene (HDPE) sample containers and stored at 4°C or below. Ground water samples collected for nitrate analysis were stored in 200 mL HDPE sample containers and acidified (pH < 2) with sulfuric acid. All analysis for reduced inorganic species (e.g. ferrous iron, nitrite, and methane) were performed immediately in the field.

2.2.5.2 Sample Container and Labels

Sample containers and appropriate container lids were provided by the EPA Mobile Laboratory. The sample containers were filled as described in Sections 2.2.3.1.4, 2.2.3.2.4, and 2.2.3.3, and the container lids were tightly closed. Samples to be analyzed for VOCs were collected into containers with zero headspace. The sample label was firmly attached to the container side, and the following information was legibly and indelibly written on the label:

- Facility name;
- Sample identification;
- Sample type (ground water);
- Sampling date;
- Sampling time;
- Preservatives added; and,
- Sample collector's initials.

2.2.5.3 Sample Shipment

After the samples were sealed and labeled, they were packaged for immediate transport to the onsite USEPA Mobile Laboratory. The following packaging and labeling procedures were followed:

- Sample was packaged to prevent leakage or vaporization from its container;
- Shipping container was labeled with
  - Sample collector's name, address, and telephone number;
  - Laboratory's name, address, and telephone number;
  - Description of sample;
  - Quantity of sample; and
  - Date of transfer to onsite laboratory.

The packaged samples were delivered to the USEPA Mobile Laboratory. Delivery occurred shortly after sample acquisition.

2.3 AQUIFER TESTING

2.3.1 Slug Testing

Slug tests were conducted to estimate the hydraulic conductivity of the shallow saturated zone at UST Site 870. Slug tests are single-well hydraulic tests used to determine the hydraulic conductivity of an aquifer in the immediate vicinity of the tested well. Slug tests can be used for both confined and unconfined aquifers that have a transmissivity of less than 7,000 square feet per day (ft^2/day). Slug testing can be performed using either a rising head or a falling head test. Rising head tests generally give more accurate results and were used at this site. Slug tests were performed in monitoring wells EPA 82-C, EPA 82-F, EPA 82-G, EPA 82-H, and EPA 82-I. Detailed slug testing procedures are presented in the *Draft Technical Protocol for Implementing the Intrinsic Remediation with Long-Term Monitoring Option for Natural Attenuation of Dissolved-Phase Fuel Contamination in Ground Water* (Wiedemeier *et al.*, 1994), hereafter referred to as the Technical Protocol document.

2.3.1 Slug Test Data Analysis

Data obtained during slug testing were analyzed using AQTESOLV software and the method of Bouwer and Rice (1976) and Bouwer (1989) for unconfined conditions. The results of slug testing are presented in Section 3.3.

2.4 SURVEYING

After completion of field work all new monitoring wells, soil boring locations, and those Geoprobe® sampling locations not located immediately adjacent to a CPT test location were surveyed by a State of Utah licensed professional land surveyor. Horizontal location was surveyed to the nearest 0.1 foot. Datum and ground surface elevations for were surveyed to the nearest 0.01 foot.

SECTION 3

PHYSICAL CHARACTERISTICS OF THE STUDY AREA

This section incorporates data collected during investigations as summarized by JMM (1993b) and MWI (1994a and 1994b), and more recent investigations conducted by Parsons ES in conjunction with researchers from the USEPA RSKERL in August 1993 and July 1994, to describe the physical characteristics of UST Site 870. The investigative techniques used by Parsons ES and RSKERL researchers to determine the physical characteristics of UST Site 870 are discussed in Section 2.

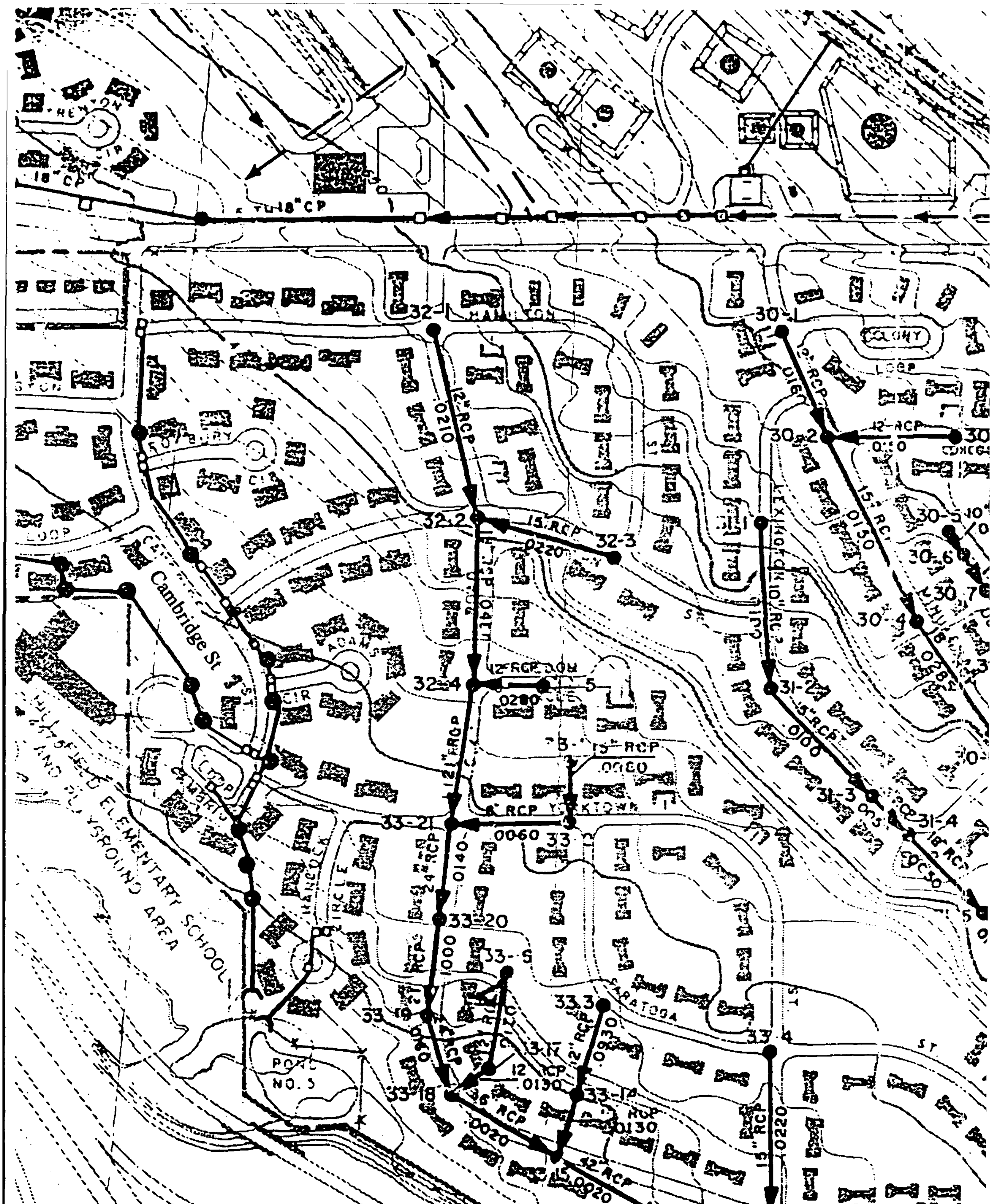
3.1 SURFACE FEATURES

3.1.1 Topography and Surface Water Hydrology

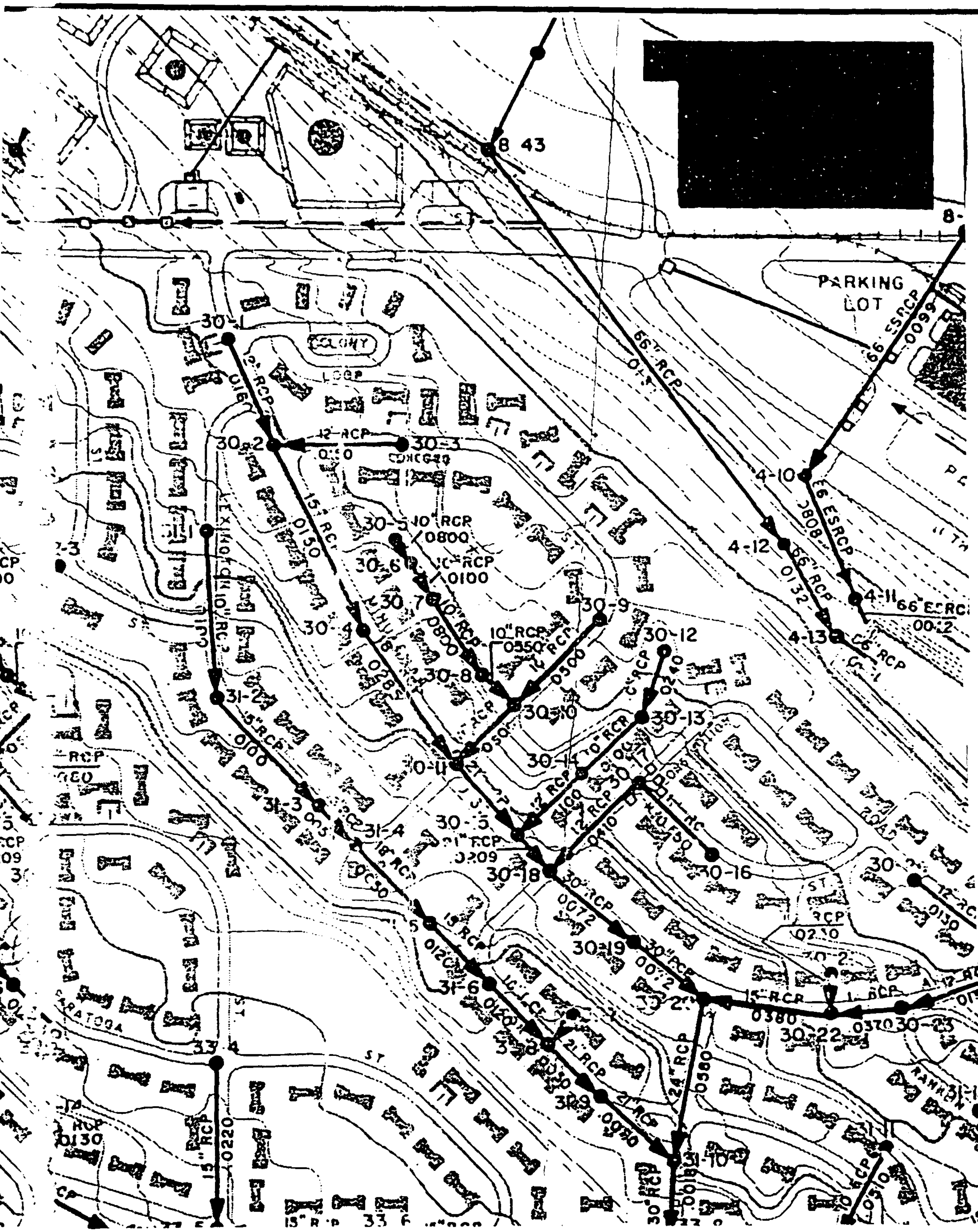
UST Site 870 is located on a plateau-like bench formed by the paleodelta of the ancient Weber River. This delta was formed as the Weber River deposited its sediment load when it entered ancient Lake Bonneville. Surface topography at the site slopes to the southwest (Figure 1.1). There are no naturally occurring surface water bodies in the immediate vicinity of UST Site 870. There are, however, several manmade features at or near the site that influence surface water runoff. These features are discussed in Section 3.1.2.

3.1.2 Manmade Features

Surface cover at UST Site 870 and adjacent areas consists of asphalt paving, grass, residential housing, concrete overlays, etc. Precipitation either infiltrates into the ground surface or is collected in gutters along the numerous roads in the Patriot Hills housing complex and diverted into several stormwater sewers in the Patriot Hills housing area. Figure 3.1 shows the locations of stormwater sewers in the area. One storm sewer, located along Cambridge Street, potentially intercepts ground water flow. There is a stormwater collection pond (Pond 5) located to the southwest of the Patriot Hills Housing Area (Figure 3.1).



18" CP
Cambridge St
32-1
30-1
COLONY
LOOP
12" RCP
0210
30-2
32-2
15" RCP
0220
32-3
30-4
32-4
31-2
31-3
31-4
YORKTOWN
33-21
33-20
33-19
33-18
33-3
33-4
SARATOGA
POND NO. 5
ELEMENTARY SCHOOL
PLAYGROUND AREA



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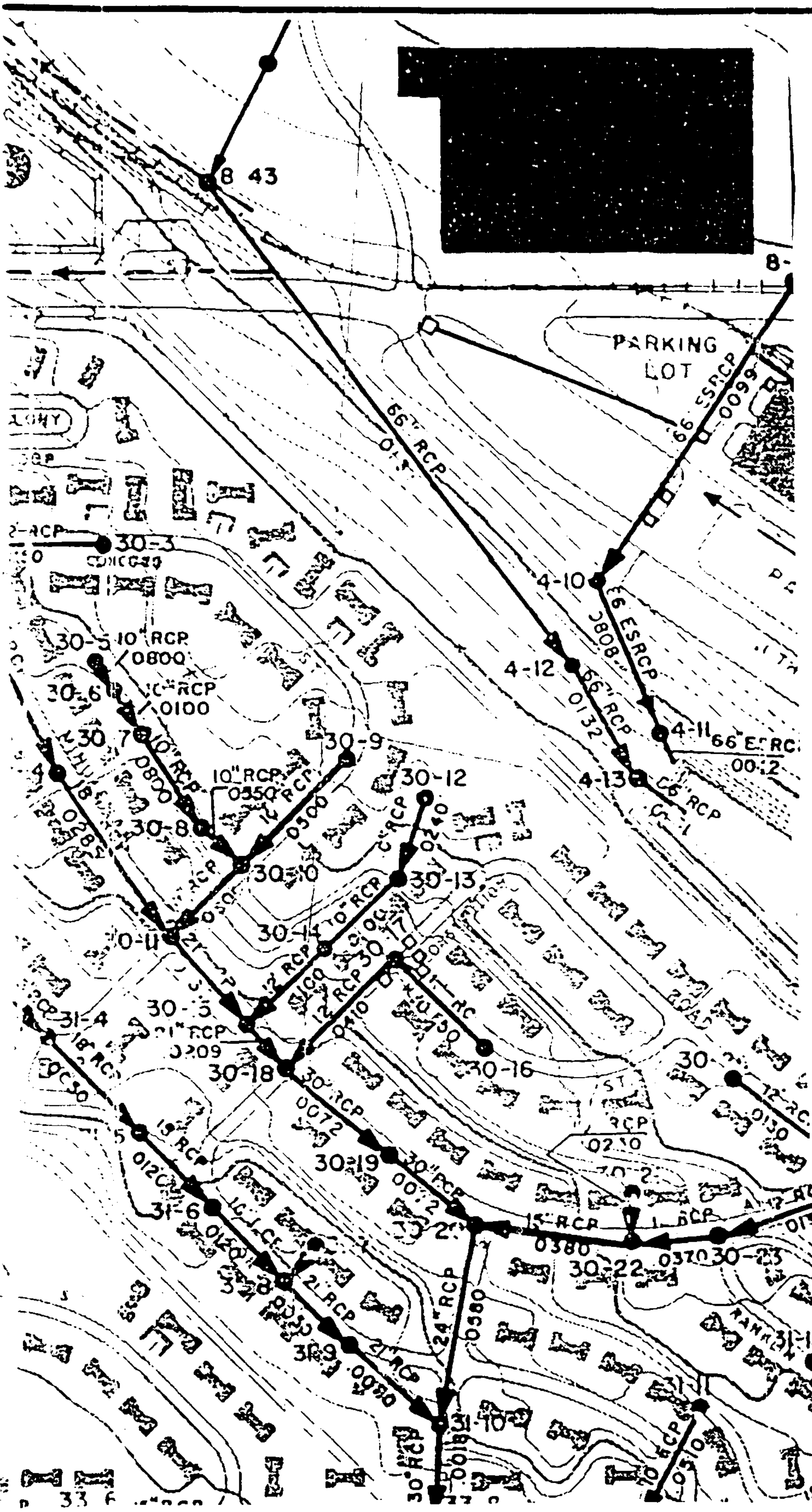


LEGEND

STORM SEWER

0 250 500
FEET

FIGURE 3.1

STORM SEWER LAYOUT

UST Site 870
Intrinsic Remediation EE/CA
Hill Air Force Base, Utah

PARSONS ENGINEERING SCIENCE, INC.

Denver, Colorado

3.2 REGIONAL GEOLOGY AND HYDROGEOLOGY

Three aquifers are present in the vicinity of UST Site 870. In order of increasing depth, these aquifers are the shallow aquifer, the Sunset Aquifer, and the Delta Aquifer. Hill AFB is located just west of the Wasatch Front in north-central Utah. Sediment comprising the shallow subsurface in the area consists of unconsolidated clay, silt, sand, and gravel which was eroded from the Wasatch Front and deposited as fluvial-deltaic basin-fill deposits where the ancient Weber River entered Lake Bonneville during Quaternary and Recent times (Feth *et al.*, 1966).

The shallow aquifer in the vicinity of UST Site 870 is the subject of this study and is discussed in detail in the following sections. Insufficient data are available for ground water in the Sunset Aquifer beneath UST Site 870 to allow an assessment of ground water quality. Total dissolved solids (TDS) values for the Delta Aquifer range from 156 to 354 milligrams per liter (mg/L) (JMM, 1993b). These TDS values, and the fact that no regulated contaminants have been detected in ground water of the Delta Aquifer, allow this aquifer to be classified as Class IA (Pristine Ground Water) under Utah Administrative Code (UAC) R448-6-3.

3.3 SITE GEOLOGY AND HYDROGEOLOGY

Characterization of the vadose zone and shallow aquifer system at UST Site 870 has been the objective of several site investigations. MWI (formerly JMM) installed 44 CPT test holes (some of which contain piezometers) and 14 ground water monitoring wells (MW prefix) at UST Site 870. Figure 1.2 shows the locations of these test holes and wells. During the week of 2 August 1993, Parsons ES, in conjunction with researchers from the USEPA RSKERL, collected 17 Geoprobe® ground water samples at 9 locations (shallow and deep testing) next to the CPT locations previously investigated by MWI. During the week of 16 August 1993, Parsons ES, in conjunction with researchers from the RSKERL, drilled eight soil borings in which ground water monitoring wells were installed. These soil boreholes/monitoring wells are designated EPA-82-A, EPA-82-B, EPA-82-C, EPA-82-D, EPA-82-E, EPA-82-F, EPA-82-H, and EPA-82-I (Sample location designation EPA 82-G was used for ground water samples collected from the stormwater drain running parallel to Cambridge Street) During the week of 4 July 1994, Parsons ES, in conjunction with researchers from the RSKERL, drilled two soil borings designated EPA-82-J and EPA-82-KK. A monitoring well, designated EPA-82-J was installed in soil boring EPA-82-J. No monitoring well was installed in soil boring EPA-82-KK. Table 2.1 presents available well and piezometer completion information.

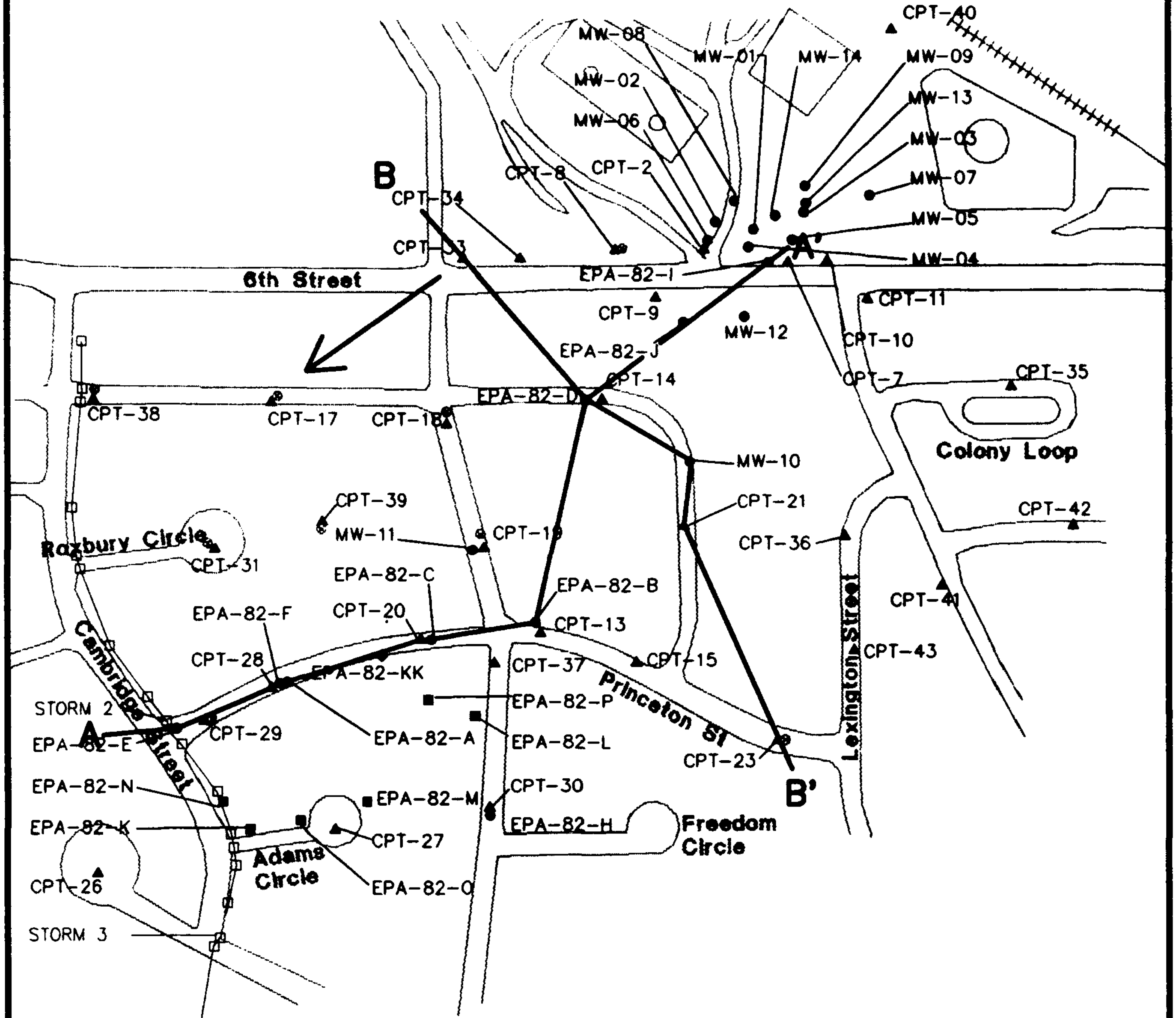
3.3.1 Lithology and Stratigraphic Relationships

The shallow sediments underlying UST Site 870 and the Patriot Hills housing area are comprised of shallow, light reddish-brown to dark gray, cohesive clayey silts to silty clays. This clayey silt to silty clay interval ranges in thickness from approximately 4 feet to 15 feet and is abruptly underlain by poorly to moderately sorted, yellowish-brown to reddish-brown, silty fine-grained sands that coarsen downward into moderately sorted medium- to coarse-grained sands. These sands range in thickness from approximately 3 to 22 feet and the shallow saturated zone at the site occurs within these sands. Underlying the sands is a sequence of competent, thinly interbedded clay to silty clay and fine- to very-fine-grained clayey sand and silt of unknown thickness. This sequence of interbedded clay and fine-grained sand and silt appears to act as an effective barrier to the vertical migration of water and contaminants.

These stratigraphic relationships are illustrated by hydrogeologic sections A-A' and B-B'. Figure 3.2 shows the locations of these sections. Figure 3.3 presents hydrogeologic section A-A', which is oriented approximately parallel to the direction of ground water flow. Figure 3.4 presents hydrogeologic section B-B', which is oriented approximately perpendicular to the direction of ground water flow.

3.3.2 Grain Size Distribution

Grain size analyses were performed by JMM on soil samples from the soil borings completed as monitoring wells MW-5 (sample collected from approximately 31 feet bgs) and MW-6 (sample collected from approximately 31 feet bgs). Both samples are representative of the deep interbedded clay to silty clay and fine- to very-fine-grained clayey sand and silt described earlier. Seventy to 90 percent of the soils from both samples passed through the #200 US Standard Sieve. The #200 sieve size represents the break between fine sand and silt, and therefore these sediments are dominated by silt and clay.



LEGEND

CPT-26 ▲	CONE PENETROMETER TEST POINT/ PIEZOMETER
MW-11 ●	MONITORING WELL LOCATION
⊗	AUGUST 1993 GEOPROBE SAMPLING LOCATION
◻	STORM DRAIN SURVEY LOCATION
EPA-82-M	JULY 1994 GEOPROBE SAMPLING
EPA-82-KK ◆	JULY 1994 SOIL BORING LOCATION
↙	GROUND WATER FLOW DIRECTION
A—A'	LINE OF HYDROGEOLOGIC SECTION

0 150 300 600
FEET

N

FIGURE 3.2

HYDROGEOLOGIC SECTION LOCATION MAP

UST Site 870
Intrinsic Remediation EE/CA
Hill Air Force Base, Utah

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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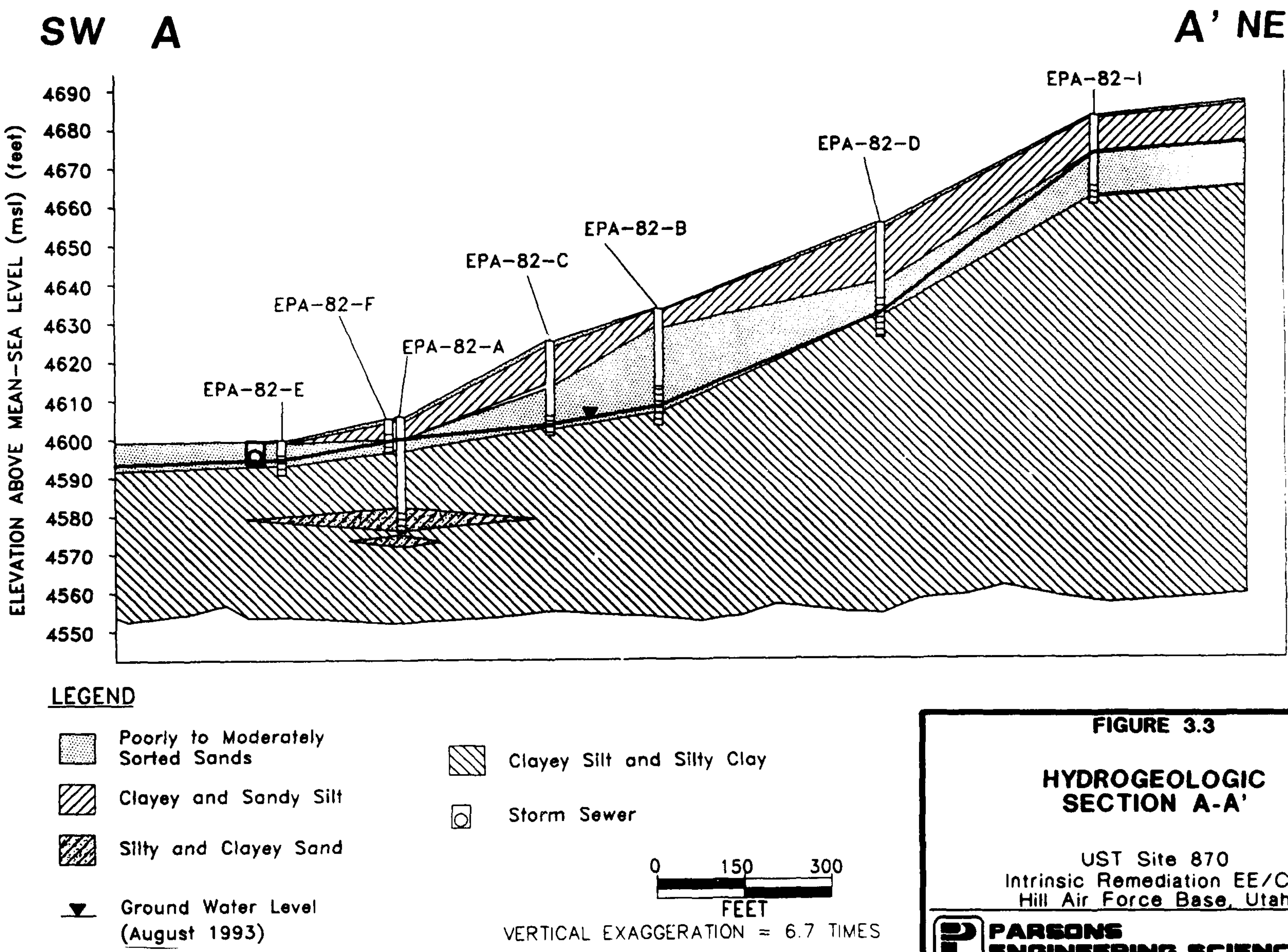

FIGURE 3.3

HYDROGEOLOGIC SECTION A-A'

UST Site 870
Intrinsic Remediation EE/CA
Hill Air Force Base, Utah

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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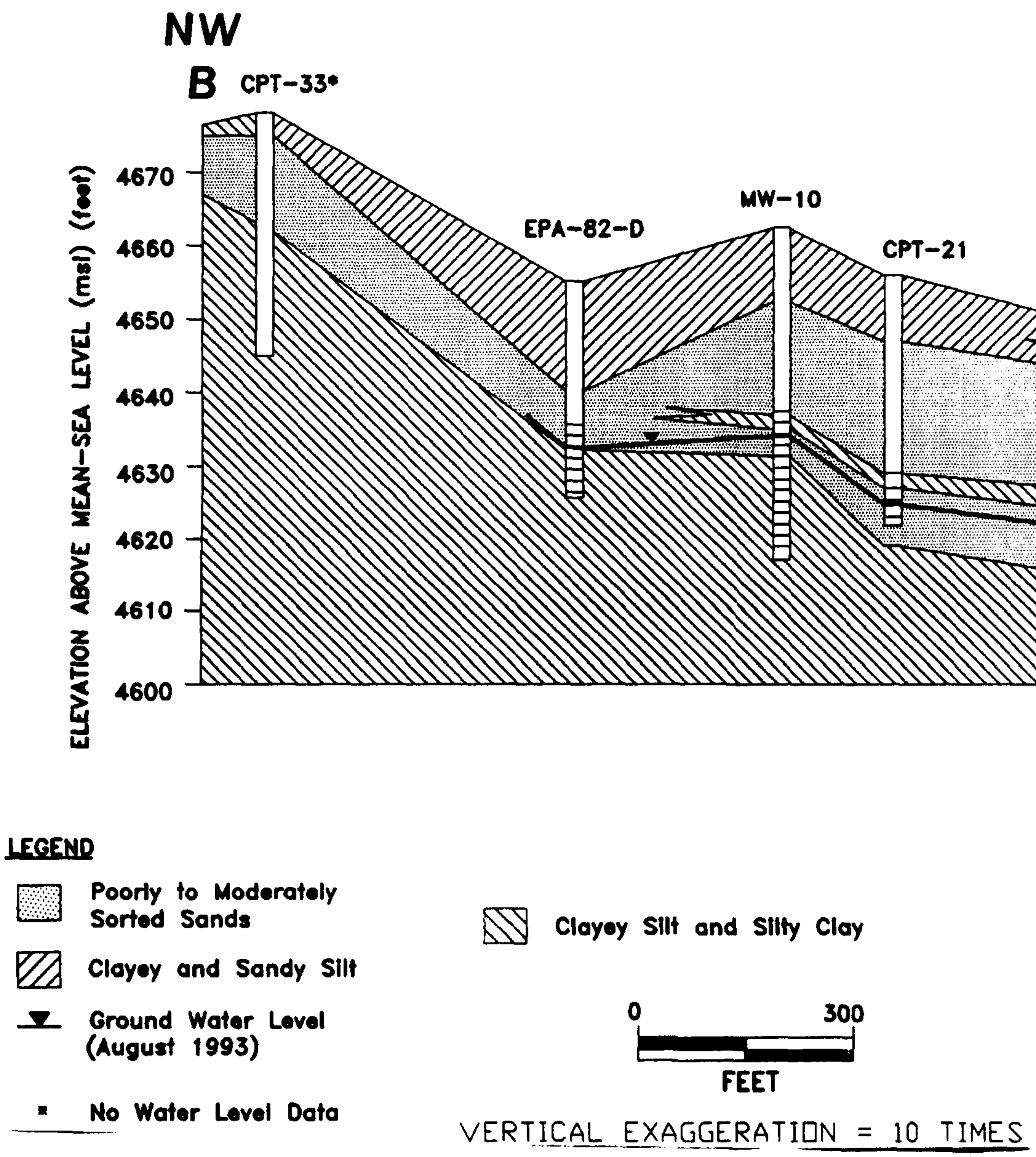

FIGURE 3.4

HYDROGEOLOGIC SECTION B-B'

UST Site 870
Intrinsic Remediation EE/CA
Hill Air Force Base, Utah

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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3.3.3 Ground Water Hydraulics

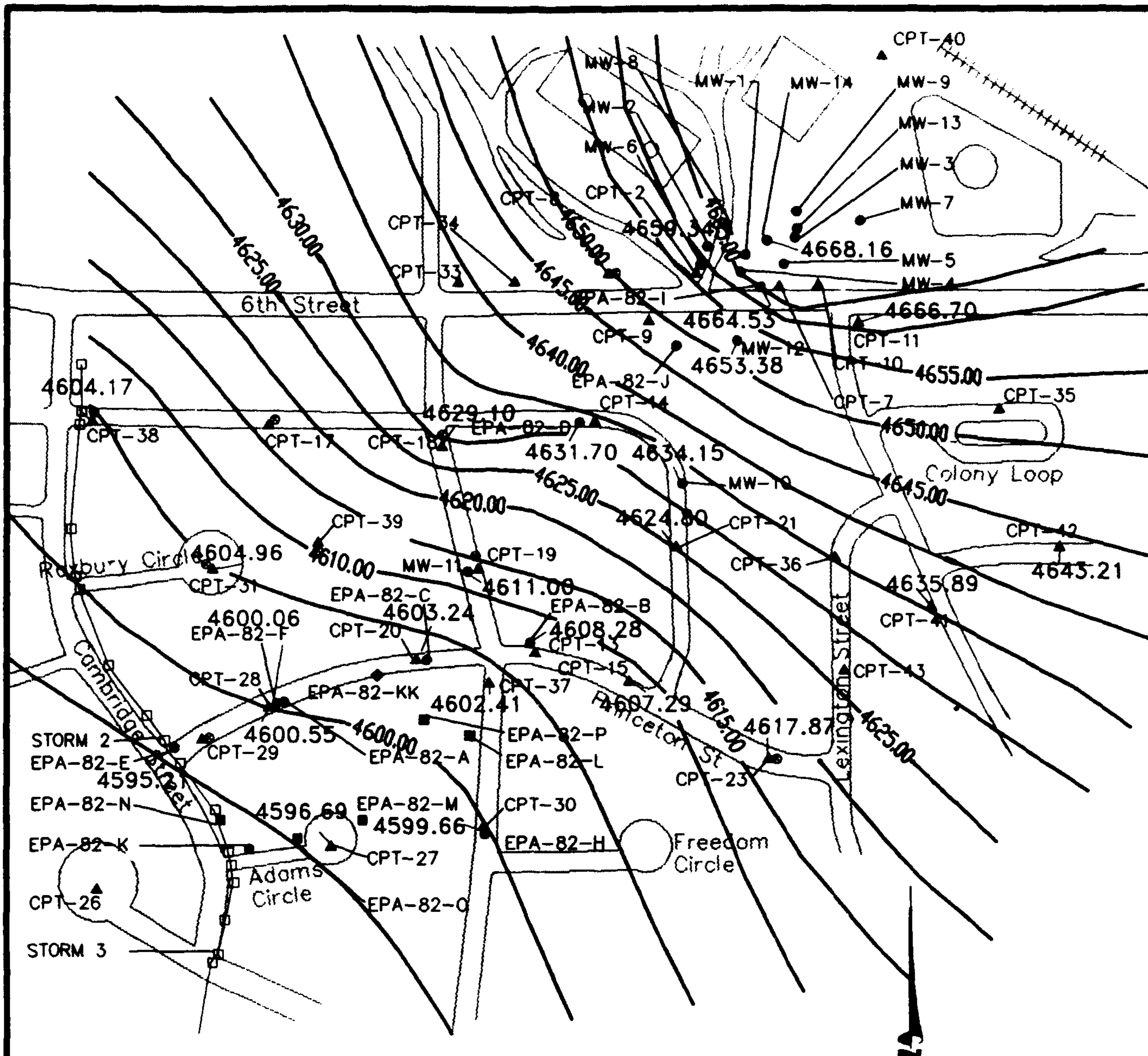
3.3.3.1 Flow Direction and Gradient

Ground water flow in the vicinity of UST Site 870 is to the southwest, with an average gradient of approximately 0.048 foot per foot (ft/ft) between wells EPA-82-I and CPT-27 (Figure 3.5). Available ground water elevation data are presented in Appendix B. Ground water flow appears to be limited to a relatively thin zone in the medium- to coarse-grained sands located immediately above the lower thinly interbedded clay to silty clay and fine- to very-fine-grained clayey sand and silt horizon (Figures 3.3 and 3.4). Available site data show that there is almost no seasonal variation in ground water flow direction or gradient at the site (Appendix B and MWI, 1994b).

3.3.3.2 Hydraulic Conductivity (K)

Hydraulic conductivity in the medium- to coarse-grained sands of the shallow saturated zone was estimated using rising head slug tests as described in Section 2. Slug tests were performed in monitoring wells EPA-82-A, EPA-82-E, EPA-82-F, EPA-82-H, and EPA-82-I. The results of these slug tests are summarized in Table 3.1. The average hydraulic conductivity for the shallow saturated zone as determined from these tests is 0.0159 foot per minute or 0.0085 centimeter per second (cm/sec). Appendix A contains slug test results. In addition, JMM (1991) performed two slug tests in monitoring well MW-01. The hydraulic conductivity as determined from these tests ranged from 0.00015 to 0.00018 cm/sec.

The average hydraulic conductivity estimated by Parsons ES for the shallow saturated zone is one to two orders of magnitude higher than hydraulic conductivities estimated by JMM (1993b). As illustrated in available borelogs for both Parsons ES and JMM, the heterogeneous site stratigraphy is composed of numerous soil types including moderately sorted, silty fine- to medium-grained sand, medium- to course-grained sands, cohesive clayey silts to silty clays, silty clay, and clayey sand. Slug tests performed by JMM at MW-1 were influenced by silty sands with a large interval (~4 ft) of clayey sand over the screened interval of the well. The locations selected by Parsons ES for slug testing (EPA installed wells) were characterized by predominately fine- to medium-grained sands over the well screen intervals; thus, higher values of hydraulic conductivity were derived because slug tests were conducted in more transmissive soils.



LEGEND

- CPT-26 ▲ CONE PENETROMETER TEST POINT/ PIEZOMETER
- MW-11 ● MONITORING WELL LOCATION
- ⊗ AUGUST 1993 GEOPROBE SAMPLING LOCATION
- □ STORM DRAIN SURVEY LOCATION
- EPA-82-M ■ JULY 1994 GEOPROBE SAMPLING LOCATION
- EPA-82-KK ◆ JULY 1994 SOIL BORING LOCATION
- 4580 LINE OF EQUAL GROUND WATER ELEVATION (FEET ABOVE MSL)

0 0 150 300 600
FEET

FIGURE 3.5

GROUNDWATER ELEVATION MAP JULY-AUGUST 1993

UST Site 870
Intrinsic Remediation EE/CA
Hill Air Force Base, Utah

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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TABLE 3.1

SLUG TEST RESULTS
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

WELL	TEST	HYDRAULIC CONDUCTIVITY (feet/sec)	HYDRAULIC CONDUCTIVITY (cm/sec)
EPA 82-A	Rising Head #1	1.19E-05	3.63E-04
EPA-82-E	Rising Head #1	5.50E-04	1.67E-02
EPA-82-E	Rising Head #2	6.08E-04	1.85E-02
EPA-82-F	Rising Head #1	1.36E-04	4.13E-03
EPA-82-F	Rising Head #2	1.08E-04	3.28E-03
EPA-82-H	Rising Head #2	2.48E-04	7.56E-03
EPA-82-H	Rising Head #3	2.73E-04	8.31E-03
EPA-82-I	Rising Head #1	1.57E-04	4.77E-03
EPA-82-I	Rising Head #2	3.58E-05	1.09E-03
	AVERAGE*	2.65E-04	8.05E-03

* Average of wells EPA-82-E, EPA-82-F, EPA-82-H, and EPA-82-I.

Well EPA-82-A completed in a sandy unit found within the deep silty clay

3.3.3.3 Effective Porosity (n_e)

Because of the difficulty involved in accurately determining effective porosity, accepted literature values for the type of soil comprising the shallow saturated zone were used. Freeze and Cherry (1979) give a range of effective porosity for sand of 0.25 to 0.50. To be conservative (lower effective porosity results in greater ground water velocity), the effective porosity for sediments of the shallow saturated zone is assumed to be 0.25.

3.3.3.4 Advective Ground Water Velocity ($\bar{v}$)

The advective velocity of ground water in the direction parallel to ground water flow is given by:

$$\bar{v} = \frac{-K}{n_e}\frac{dH}{dL}$$

Where: $\bar{v}$ = Average advective ground water velocity (seepage velocity) [L/T]

K = Hydraulic conductivity [L/T] (2.65×10^{-4} ft/sec)

dH/dL = Gradient [L/L] (0.048 ft/ft)

n_e = Effective porosity (0.25).

Using this relationship in conjunction with site-specific data, the average advective ground water velocity at the site is 4.4 feet per day (ft/day) or approximately 1,600 feet/year.

3.3.3.5 Preferential Flow Paths

Two preferential contaminant migration pathways were identified during the field work phase of this project. The first is a utility corridor on the north side of Sixth Street. This utility corridor runs parallel to Sixth Street. The influence of this corridor on contaminant migration has not been directly investigated but its influence on ground water flow is unlikely because of its relatively shallow depth.

The second potential preferential contaminant migration pathway is a storm sewer that intersects ground water flow in at least a portion of the site near Cambridge Street. This storm sewer is located along Cambridge Street (Figure 3.1). During field work conducted by Parsons ES and RSKERL personnel in August 1993, ground water appeared to be flowing in this storm sewer near the intersection of Cambridge and Princeton streets. The possibility that this water was ground water was supported by ground water elevation data and surveyor's data collected at several points along the storm sewer (e.g., culvert invert elevation data, see Figure 3.3). To determine if contaminated ground water was being intercepted by this storm sewer, two water samples, storm-2 and storm-3, were collected at the locations shown in Figure 1.2. The analytical results for these samples indicated that no ground water contamination was being intercepted by the storm drain in August 1993.

3.3.5 Ground Water Use

Ground water from the surficial aquifer at Hill AFB is not extracted for potable uses. Water is obtained from on-base deep supply wells in the months of October through April. Water is supplied by a combination of deep supply wells and water piped in from the nearby Weber Basin Water Conservancy District during the remainder of the year.

3.4 CLIMATOLOGICAL CHARACTERISTICS

Regional climatological characteristics for the site were obtained from an AWS Climatic Brief. Meteorology at the site is impacted by the Wasatch Range located west of the site. This range is oriented north-south and rises over 5,000 vertical feet above the valley floor in less than 5 miles, causing an abrupt barrier for Pacific frontal systems moving into northern Utah. This barrier, coupled with moisture from the Great Salt Lake, causes fronts to build up over Hill AFB, resulting in low cloud ceilings and prolonged periods of precipitation.

Monthly mean high temperatures range from about 27 °F in January to about 76 °F in July. Recorded extreme high and low temperatures for the period from 1941 to 1984 were 104 °F and -13 °F, respectively. Mean annual precipitation for this same period is 20.1 inches.

SECTION 4

NATURE AND EXTENT OF CONTAMINATION AND SOIL AND GROUND WATER GEOCHEMISTRY

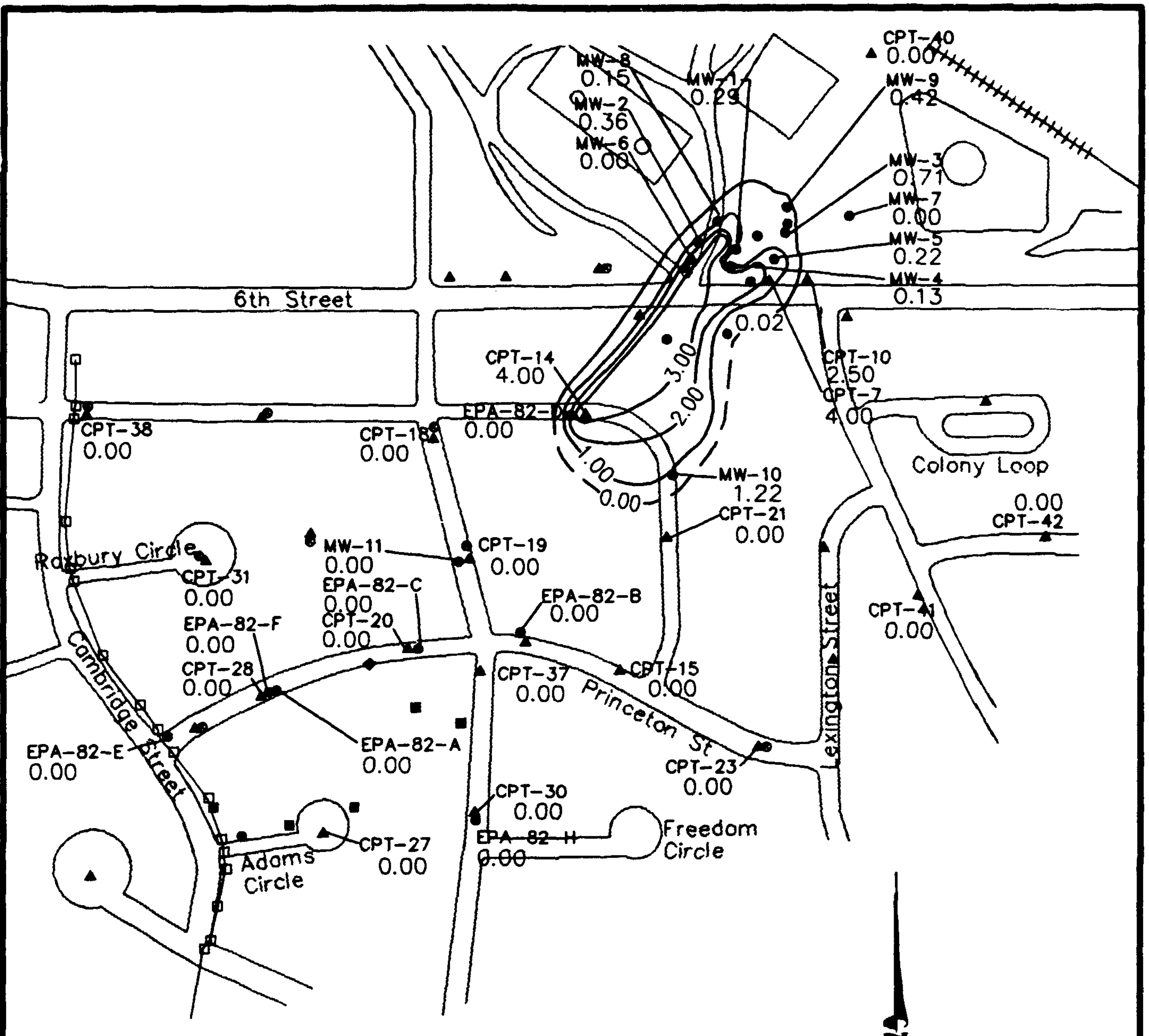
4.1 SOURCE OF CONTAMINATION

The source of contamination at UST Site 870 it not known with any degree of certainty, nor is it known how much fuel leaked into the subsurface. About 700 gallons of LNAPL have been recovered by product recovery systems since their installation in June 1992. Former UST 870.0 may have contributed to the contamination observed at the site, but it is unlikely that leakage from this UST was responsible for all of the contamination. This UST was used to store condensate and residual JP-4 generated by operations at a nearby filter stand. Following the removal of UST 870.0, a new tank equipped with leak-detection equipment was installed in the same excavation. Based on the large quantity of contamination, other potential sources of contamination include: leaky piping associated with the UST, surface spills and releases from operations since the 1940s, and a faulty 6-inch diameter pipe located behind the pump facility Building 870 (pending repairs).

4.2 SOIL CHEMISTRY

4.2.1 Mobile LNAPL Contamination

Mobile LNAPL is defined as the LNAPL that is free to flow in the aquifer and that will flow from the aquifer matrix into a well under the influence of gravity. Mobile LNAPL is present in several monitoring wells and piezometers at the site (Appendix B). Figure 4.1 is an isopach map showing the distribution and measured thickness of mobile LNAPL at the site in July and August 1993. This map was prepared using the greatest mobile LNAPL thickness measured at each location during this period. The LNAPL plume appears to be comprised of weathered JP-4 that emanates from the aboveground storage tank facility. Figure 4.1 suggests that the LNAPL plume extended approximately 750 feet downgradient from the source area in July/August 1993. The areal extent of suspected mobile LNAPL contamination is approximately 225,000 square



LEGEND

CPT-26 ▲	CONE PENETROMETER TEST POINT/ PIEZOMETER
MW-11 ●	MONITORING WELL LOCATION
●	AUGUST 1993 GEOPROBE SAMPLING LOCATION
□	STORM DRAIN SURVEY LOCATION
EPA-82-M ■	JULY 1994 GEOPROBE SAMPLING LOCATION
EPA-82-KK ◆	JULY 1994 SOIL BORING LOCATION
— 1.00 —	LINE OF EQUAL LNAPL THICKNESS (FEET) (GREATEST THICKNESS FOR JULY/ AUGUST 1993)

CONTOUR INTERVAL = 1 FOOT

0 0 150 300 600
FEET

FIGURE 4.1

LNAPL ISOPACH MAP JULY/AUGUST 1993

UST Site 870
Intrinsic Remediation EE/CA
Hill Air Force Base, Utah

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

L:\45?02\DRAWINGS\95DN0450, 3/20/95 at 10:00 LAYER: LNAPL

feet. Concentrations of BTEX and trimethylbenzene (TMB) constituents in the mobile LNAPL were quantitated using a sample of LNAPL collected from MW-10 in August 1993. Concentrations of BTEX and TMBs in this sample indicate that the JP-4 comprising the LNAPL plume in this area is significantly weathered. Table 4.1 compares BTEX concentrations in fresh JP-4 to those observed in LNAPL from MW-10. Toluene and benzene concentrations are reduced by 1 to 3 orders of magnitude, respectively, and ethylbenzene and total xylene concentrations are reduced by about one-half.

TABLE 4.1

COMPARATIVE FRESH AND WEATHERED LNAPL BTEX ANALYTICAL RESULTS UST SITE 870 INTRINSIC REMEDIATION EE/CA HILL AFB, UTAH

Contaminant	Concentration in Fresh JP-4 (mg/L)	Concentration in Weathered JP-4 from MW-10 (August, 1993) (mg/L)
Benzene	3750	1
Toluene	9975	134
Ethylbenzene	2775	1020
o -xylene	7575	2380
m -xylene	7200	5500
p -xylene	2625	1070

The relationship between measured LNAPL thickness and the amount of mobile LNAPL in the subsurface at a site is extremely difficult to quantify. Based on soil core data and measured LNAPL thicknesses, there appears to be a significant difference between measured LNAPL thickness and the actual thickness of mobile LNAPL present at the site. It is well documented that LNAPL thickness measurements taken in ground water monitoring wells are not indicative of actual mobile LNAPL thicknesses in the formation (Kemblowski and Chiang, 1990; Concawe, 1979; Abdul *et al.*, 1989; Testa and Paczkowski, 1989; Hughes *et al.*, 1988; Blake and Hall, 1984; Hall *et al.*, 1984; Hampton and Miller, 1988; Mercer and Cohen, 1990; de Pastrovich *et al.*,

1979; Lehnard and Parker, 1990; Ballestero, *et al.*, 1994). It has been noted by these authors that the thickness of LNAPL measured in a monitoring well is greater that the actual mobile LNAPL thickness present in the aquifer and, according to Mercer and Cohen (1990), measured LNAPL thickness in wells is typically 2 to 10 times greater than the actual mobile LNAPL thickness in the formation.

4.2.2 Residual-Phase (Stationary) LNAPL Contamination

Residual-phase LNAPL is defined as the LNAPL that is trapped in the aquifer by the processes of cohesion and capillarity and therefore will not flow within the aquifer and will not flow from the aquifer matrix into a well under the influence of gravity. The following sections describe the residual-phase LNAPL contamination found at UST Site 870.

4.2.2.1 Soil BTEX Contamination

Residual-phase BTEX contamination resulting from vertically and laterally migrating LNAPL is found over a wide area at UST Site 870. Table 4.2 contains soil BTEX and TPH data. Figure 4.2 is an isopleth map showing maximum observed total BTEX concentrations in soil at UST Site 870. Soil BTEX contamination appears to extend approximately 1,600 feet downgradient from the source area and is approximately 500 feet wide at the widest point. The highest observed concentration of residual-phase BTEX is 554 mg/kg in a soil core sample taken from approximately 18 feet bgs in soil boring EPA-82-I, which is in the suspected source area of JP-4 contamination. This corresponds with the highest measured TPH concentration of 28,300 mg/kg. Measured total BTEX concentrations decrease rapidly in areas devoid of mobile-phase LNAPL contamination, and the majority of the area shown in Figure 4.2 is characterized by total BTEX concentrations of less than 50 mg/kg.

4.2.2.2 Soil TPH Contamination

Figure 4.3 is an isopleth map showing TPH concentrations in soil. This figure shows that elevated TPH concentrations are widespread at the site. TPH levels exceed 28,000 mg/kg at EPA-82-I. TPH contamination appears to extend downgradient from the source area for approximately 1,600 feet with an approximate width of 450 feet. The vertical thickness of TPH

TABLE 4.2
FUEL HYDROCARBON COMPOUNDS DETECTED IN SOIL
UST SITE 870 INTRINSIC REMEDATION EE/CA
HILL AFB, UTAH

Sample Location*	Sample Date	Sample Interval Top (ft bgs)	Sample Interval Bottom (ft bgs)	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	P-Xylene (mg/kg)	M-Xylene (mg/kg)	M&P-Xylene (mg/kg)	O-Xylene (mg/kg)	Total Xylenes (mg/kg)	Total BTEX (mg/kg)	1,3,5-TMB (mg/kg)	1,2,4-TMB (mg/kg)	1,2,3-TMB (mg/kg)	TPH (mg/kg)
82 A-16	8/17/93	18.75	19.00	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-15	8/17/93	19.00	19.25	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-14	8/17/93	19.25	19.50	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-13	8/17/93	19.50	19.75	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-12	8/17/93	19.75	20.00	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-11	8/17/93	20.00	20.25	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-10	8/17/93	20.25	20.50	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-09	8/17/93	20.50	20.75	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-08	8/17/93	20.75	21.00	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-07	8/17/93	21.00	21.25	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-06	8/17/93	21.25	21.50	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-05	8/17/93	21.50	21.75	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-04	8/17/93	21.75	22.00	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-03	8/17/93	22.00	22.25	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-02	8/17/93	22.25	22.50	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-01	8/17/93	22.50	22.75	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-25	8/17/93	22.75	23.00	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-24	8/17/93	23.00	23.40	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-23	8/17/93	23.40	23.80	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-22	8/17/93	23.80	24.20	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-21	8/17/93	24.20	24.60	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-20	8/17/93	24.60	25.00	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-19	8/17/93	25.00	25.40	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-18	8/17/93	25.40	25.80	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-17	8/17/93	25.80	26.20	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-41	8/17/93	27.00	27.30	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-40	8/17/93	27.30	27.60	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-39	8/17/93	27.60	27.90	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-38	8/17/93	27.90	28.20	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-37	8/17/93	28.20	28.50	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-36	8/17/93	28.50	28.80	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-35	8/17/93	28.80	29.10	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-34	8/17/93	29.10	29.40	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-33	8/17/93	29.40	29.70	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-32	8/17/93	29.70	30.00	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-31	8/17/93	30.00	30.30	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-30	8/17/93	30.30	30.60	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-29	8/17/93	30.60	30.90	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA

TABLE 4.2 (Continued)
FUEL HYDROCARBON COMPOUNDS DETECTED IN SOIL
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

Sample Location	Sample Date	Sample Interval Top (ft bgs)	Bottom (ft bgs)	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	P-Xylene (mg/kg)	M-Xylene (mg/kg)	M&P-Xylene (mg/kg)	O-Xylene (mg/kg)	Total Xylenes (mg/kg)	Total BTEX (mg/kg)	1,3,5-TMB (mg/kg)	1,2,4-TMB (mg/kg)	1,2,3-TMB (mg/kg)	TPH (mg/kg)
82 A-28	8/17/93	30.90	31.20	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-27	8/17/93	31.20	31.50	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-54	8/17/93	31.50	31.80	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-53	8/17/93	31.80	32.10	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-52	8/17/93	32.10	32.40	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-51	8/17/93	32.40	32.70	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-50	8/17/93	32.70	33.00	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-49	8/17/93	33.00	33.30	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-48	8/17/93	33.30	33.60	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-47	8/17/93	33.60	33.90	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-46	8/17/93	33.90	34.20	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-45	8/17/93	34.20	34.50	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-44	8/17/93	34.50	34.80	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-43	8/17/93	34.80	35.10	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 A-42	8/17/93	35.10	35.40	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 B-12	8/18/93	20.00	20.30	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 B-11	8/18/93	20.30	20.60	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 B-10	8/18/93	20.60	20.90	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 B-09	8/18/93	20.90	21.20	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 B-08	8/18/93	21.20	21.50	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 B-07	8/18/93	21.50	21.80	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 B-06	8/18/93	21.80	22.10	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 B-05	8/18/93	22.10	22.40	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 B-04	8/18/93	22.40	22.70	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 B-02	8/18/93	22.70	23.00	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 B-01	8/18/93	23.00	23.30	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
NSN	8/18/93	23.30	23.60	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA
NSN	8/18/93	23.60	23.90	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA
82 B-24	8/18/93	23.90	24.10	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 B-23	8/18/93	24.10	24.40	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 B-22	8/18/93	24.40	24.70	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 B-21	8/18/93	24.70	25.00	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 B-20	8/18/93	25.00	25.30	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 B-19	8/18/93	25.30	25.60	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 B-18	8/18/93	25.60	25.90	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 B-17	8/18/93	25.90	26.10	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 B-16	8/18/93	26.10	26.40	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 B-15	8/18/93	26.40	26.70	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA

TABLE 4.2 (Continued)
FUEL HYDROCARBON COMPOUNDS DETECTED IN SOIL
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

Sample Location	Sample Date	Sample Interval Top (ft bgs)	Sample Interval Bottom (ft bgs)	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	P-Xylene (mg/kg)	M-Xylene (mg/kg)	M&P-Xylene (mg/kg)	O-Xylene (mg/kg)	Total Xylenes (mg/kg)	Total BTEX (mg/kg)	1,3,5-TMB (mg/kg)	1,2,4-TMB (mg/kg)	1,2,3-TMB (mg/kg)	TPH (mg/kg)
82 B-14	8/18/93	26.70	27.10	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 B-13	8/18/93	27.10	27.40	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 C-26	8/18/93	19.90	20.20	BLQI	BLQI	0.0118	0.0178	0.0418	NA	0.00716	0.06676	0.07856	0.029	0.0371	0.0145	< 10.0
82 C-25	8/18/93	20.20	20.50	BLQI	BLQI	0.0124	0.0221	0.0521	NA	0.0136	0.0878	0.1002	0.0388	0.054	0.0229	< 10.0
82 C-24	8/18/93	20.50	20.80	BLQI	BLQI	0.00795	0.0105	0.0189	NA	BLQI	0.0294	0.03735	0.0148	0.0168	0.00363	< 10.0
82 C-23	8/18/93	20.80	21.10	BLQI	BLQI	0.00642	0.011	0.00991	NA	BLQI	0.0294	0.02733	0.0801	0.0741	0.00813	< 10.0
82 C-22	8/18/93	21.10	21.40	0.00327	0.02	0.0286	0.0857	0.0662	NA	BLQI	0.1519	0.20377	3.7	4.42	0.905	352
82 C-21	8/18/93	21.40	21.55	0.00367	0.0192	0.00558	0.0365	0.00956	NA	BLQI	0.04606	0.07451	2.34	2.04	0.208	173
82 C-20	8/18/93	21.55	21.70	< 0.01	0.0176	0.00618	0.0296	0.0091	NA	0.00401	0.04271	0.06649	1.5	1.03	0.0553	580(EST)
82 C-19	8/18/93	21.70	22.00	0.00621	< 0.01	0.018	0.042	0.0257	NA	0.0151	0.0828	0.10701	1.65	1.16	0.108	444
82 C-16	8/18/93	22.10	22.30	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	0.0139	0.0167	0.00491	< 10.0
82 C-14	8/18/93	22.30	22.60	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	< 10.0
82 D-06	8/20/93	21.50	21.80	BLQI	BLQI	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 D-05	8/20/93	21.80	22.10	BLQI	BLQI	BLQI	BLQI	< 0.01	NA	BLQI	BLQI	BLQI	BLQI	0.00498	BLQI	< 10.0
82 D-04	8/20/93	22.10	22.40	BLQI	BLQI	0.00871	0.0136	0.0345	NA	0.00451	0.05261	0.06132	0.195	0.225	0.0548	< 10.0
82 D-03	8/20/93	22.40	22.80	< 0.01	BLQI	0.00335	BLQI	0.00336	NA	BLQI	0.00336	0.00671	0.0174	0.00885	0.00311	< 10.0
82 D-01	8/20/93	23.80	24.00	0.00959	BLQI	0.0159	BLQI	BLQI	NA	BLQI	BLQI	0.02549	0.00416	BLQI	BLQI	< 10.0
82 D-25	8/20/93	24.00	24.10	0.0103	BLQI	0.0106	0.00575	0.0143	NA	0.00359	0.02364	0.04454	0.00744	0.00702	BLQI	NA
82 D-24	8/20/93	24.10	24.40	0.129	BLQI	0.264	0.276	0.555	NA	0.144	0.975	1.368	0.373	0.44	0.135	< 10.0
82 D-23	8/20/93	24.40	24.70	0.271	BLQI	1.48	1.62	3.4	NA	0.732	5.752	7.503	2.53	3.11	0.817	< 10.0
82 D-22	8/20/93	24.70	25.00	0.0697	BLQI	0.111	0.013	BLQI	NA	BLQI	0.013	0.1937	0.0304	0.0111	BLQI	< 10.0
82 D-21	8/20/93	25.00	25.30	0.0104	BLQI	0.0949	BLQI	0.00303	NA	BLQI	0.00303	0.10833	0.00477	0.0031	< 0.01	NA
82 D-19	8/20/93	25.60	25.90	0.00829	BLQI	0.0604	0.0388	0.00529	NA	0.00577	0.04986	0.11855	0.0882	0.078	0.00821	NA
82 D-18	8/20/93	25.90	26.20	0.00792	BLQI	0.0344	BLQI	BLQI	NA	BLQI	BLQI	0.03232	0.0258	BLQI	< 0.01	NA
82 D-17	8/20/93	26.20	26.50	0.0063	BLQI	0.0213	BLQI	BLQI	NA	BLQI	BLQI	0.0276	0.0147	BLQI	< 0.01	< 10.0
82 D-16	8/20/93	26.50	26.80	0.0316	0.00304	0.0613	0.0551	0.181	NA	0.045	0.2811	0.37704	0.0365	0.0399	0.0213	< 10.0
82 D-15	8/20/93	26.80	27.00	0.0343	BLQI	0.0878	0.039	0.121	NA	0.0323	0.1923	0.3144	0.0433	0.0303	0.0127	< 10.0
82 D-14	8/20/93	27.00	27.30	0.0209	BLQI	0.124	0.0662	0.0194	NA	BLQI	0.0856	0.2305	0.0637	0.0695	0.00518	< 10.0
82 D-13	8/20/93	27.30	27.60	0.0185	BLQI	0.141	0.00755	0.0275	NA	0.00476	0.03981	0.19931	0.00871	0.00572	BLQI	NA
82 D-12	8/20/93	27.60	27.80	0.0203	BLQI	0.115	0.00454	0.0167	NA	BLQI	0.02124	0.15654	0.00632	0.00416	BLQI	NA
82 D-40	8/20/93	28.00	28.20	0.0314	BLQI	0.171	0.0378	0.111	NA	0.0242	0.173	0.3754	0.0439	0.0373	0.0163	NA
82 D-39	8/20/93	28.20	28.50	0.0388	BLQI	0.137	BLQI	0.00404	NA	0.00486	0.0189	0.1847	0.0077	BLQI	BLQI	NA
82 D-38	8/20/93	28.50	28.80	0.0393	0.00809	0.128	0.0105	0.101	NA	0.0692	0.1807	0.35609	0.0733	0.0107	0.0384	NA
82 E-03	8/21/93	2.70	3.00	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 E-02	8/21/93	3.00	3.30	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 E-17	8/21/93	4.90	5.25	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA

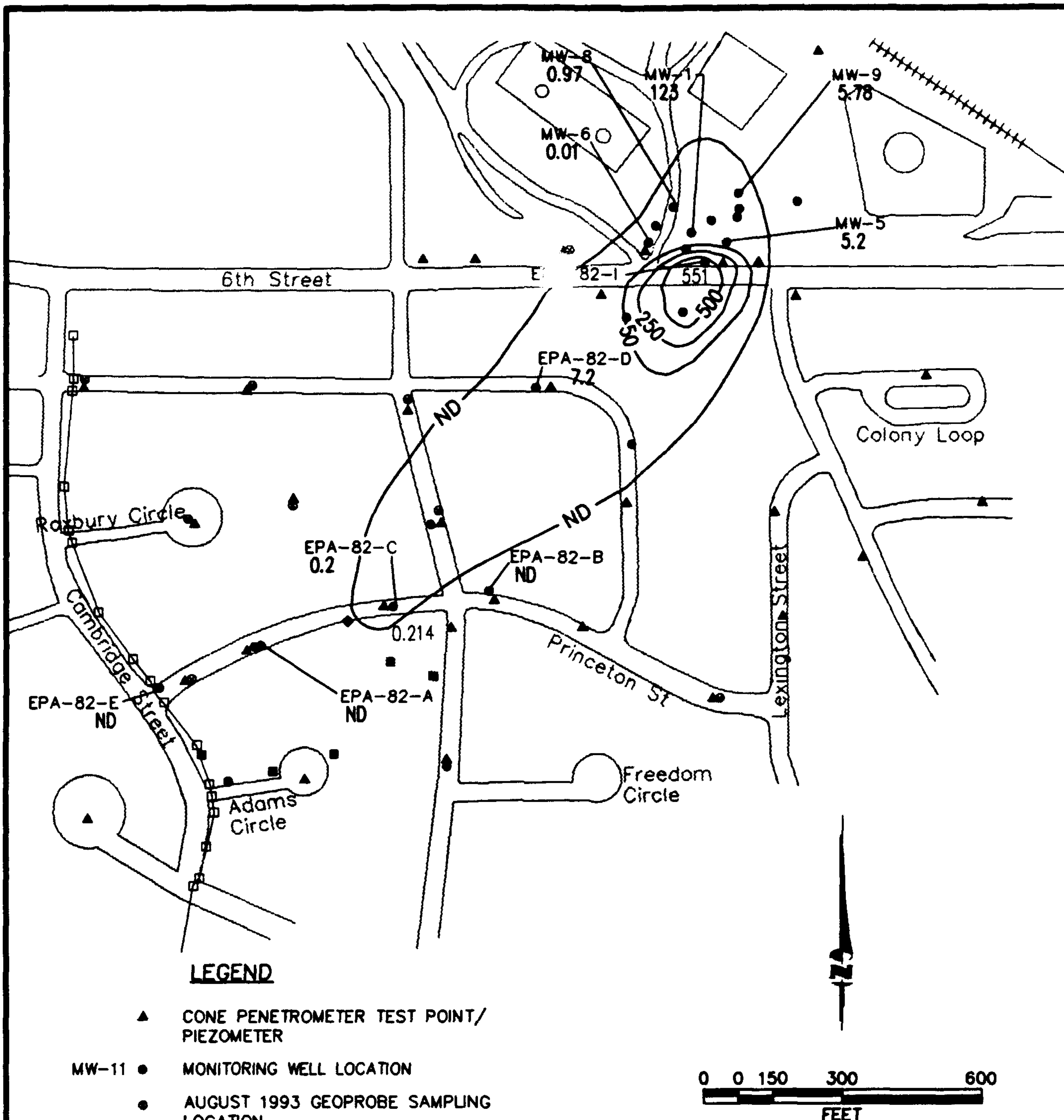
TABLE 4.2 (Continued)
FUEL HYDROCARBON COMPOUNDS DETECTED IN SOIL
UST SITE 870 INTRINSIC REMEDATION EE/CA
HILL AFB, UTAH

Sample Location	Sample Date	Sample Interval Top (ft bgs)	Sample Interval Bottom (ft bgs)	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	P-Xylene (mg/kg)	M-Xylene (mg/kg)	M&P-Xylene (mg/kg)	O-Xylene (mg/kg)	Total Xylenes (mg/kg)	Total BTEX (mg/kg)	1,3,5-TMB (mg/kg)	1,2,4-TMB (mg/kg)	1,2,3-TMB (mg/kg)	TPH (mg/kg)
82 E-15	8/21/93	5.60	5.95	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 E-14	8/21/93	5.95	6.30	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 E-13	8/21/93	6.30	6.65	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	NA	< 0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	NA
82 I-14	8/22/93	13.80	14.00	< 0.01	BLQ1	BLQ1	BLQ1	BLQ1	NA	BLQ1	<0.01	<0.01	BLQ1	BLQ1	BLQ1	NA
82 I-13	8/22/93	14.00	14.40	BLQ1	BLQ1	BLQ1	BLQ1	BLQ1	NA	BLQ1	BLQ1	BLQ1	BLQ1	BLQ1	< 0.01	NA
82 I-12	8/22/93	14.40	14.80	BLQ1	BLQ1	BLQ1	BLQ1	0.00543	NA	BLQ1	0.00543	0.00543	BLQ1	BLQ1	BLQ1	NA
82 I-11	8/22/93	14.80	15.20	BLQ1	BLQ1	BLQ1	BLQ1	BLQ1	NA	BLQ1	BLQ1	BLQ1	BLQ1	BLQ1	BLQ1	NA
82 I-10	8/22/93	15.20	15.56	< 0.01	BLQ1	BLQ1	BLQ1	0.00408	NA	BLQ1	0.00408	0.00408	BLQ1	BLQ1	BLQ1	NA
82 I-09	8/22/93	15.56	15.92	BLQ1	BLQ1	BLQ1	BLQ1	BLQ1	NA	BLQ1	BLQ1	BLQ1	BLQ1	BLQ1	BLQ1	NA
82 I-08	8/22/93	15.92	16.28	BLQ1	BLQ1	BLQ1	BLQ1	BLQ1	NA	BLQ1	BLQ1	BLQ1	BLQ1	BLQ1	< 0.01	NA
82 I-07	8/22/93	16.28	16.64	BLQ1	BLQ1	BLQ1	BLQ1	BLQ1	NA	BLQ1	BLQ1	BLQ1	BLQ1	BLQ1	BLQ1	138
82 I-06	8/22/93	16.64	17.00	BLQ1	BLQ1	BLQ1	BLQ1	BLQ1	NA	BLQ1	BLQ1	BLQ1	BLQ1	BLQ1	BLQ1	139
82 I-05	10/21/93	17.00	17.36	0.0326	0.0266	14.5	19.9	52.7	NA	18.2	90.8	105.3592	28.1	49.9	18.5	3530
82 I-05	9/1/93	17.00	17.36	1.61	0.204	11.2	23.4	63.1	NA	19.9	106.4	119.414	29.3	50.9	19.3	NA
82 I-04	8/22/93	17.36	17.72	0.517	0.235	4.83	22.3	62.3	NA	20.8	105.4	110.482	23.3	42.7	15.4	11500
82 I-03	8/22/93	17.72	18.08	4.55	2.73	47.7	105	294	NA	100	499	553.98	88.8	167	59.2	28300
82 I-02	8/22/93	18.08	18.44	0.401	12.6	17.5	34.4	99.3	NA	36.6	170.3	200.801	36.8	69.8	25.3	5160
82 I-01	8/22/93	18.44	18.80	BLQ1	0.142	0.556	1.22	3.67	NA	1.61	6.5	7.198	2.3	4.43	1.71	6080
82 I-27	8/22/93	18.80	19.12	0.49	1.73	0.377	0.625	1.84	NA	0.725	3.19	5.787	0.384	0.724	0.272	< 10.0
82 I-26	8/22/93	19.12	19.45	0.749	3.75	1.03	1.7	4.74	NA	2.04	8.48	14.009	1.24	2.54	0.958	< 10.0
82 I-25	8/22/93	19.45	19.77	0.866	0.231	0.187	0.281	0.802	NA	0.403	1.486	2.77	0.103	0.244	0.0909	< 10.0
82 I-24	8/22/93	19.77	20.09	0.787	0.159	0.15	0.228	0.616	NA	0.31	1.154	2.25	0.0743	0.195	0.0749	< 10.0
82 I-23	8/22/93	20.09	20.42	1.45	0.2	0.283	0.427	1.16	NA	0.567	2.154	4.087	0.157	0.402	0.155	< 10.0
82 I-22	8/22/93	20.42	20.74	0.771	0.0936	0.15	0.233	0.621	NA	0.318	1.172	2.1866	0.0938	0.246	0.0899	< 10.0
82 I-21	8/22/93	20.74	21.06	0.665	0.035	0.159	0.233	0.612	NA	0.321	1.166	2.025	0.0796	0.206	0.0783	NA
82 I-20	8/22/93	21.06	21.38	0.538	0.0436	0.152	0.221	0.604	NA	0.303	1.128	1.8616	0.0747	0.191	0.0709	NA
82 I-19	8/22/93	21.38	21.71	0.678	0.0455	0.16	0.243	0.517	NA	0.316	1.076	1.9595	0.0843	0.222	0.0778	NA
82 I-18	8/22/93	21.71	22.03	0.629	0.117	1.31	2.02	0.988	NA	2.31	5.318	7.374	1.62	4.72	1.25	276
82 I-17	8/22/93	22.03	22.35	0.653	0.591	3.39	4.69	4.89	NA	5.28	14.86	19.494	3.04	8.37	2.34	856(EST)
82 I-16	8/22/93	22.35	22.68	0.333	0.304	1.12	1.48	1.83	NA	1.72	5.03	6.87	0.857	2.33	0.672	< 10.0
82 I-15	8/22/93	22.68	23.00	0.501	1.07	3.72	4.81	10.5	NA	5.58	20.89	26.181	2.94	8.45	2.03	643
82 I-39	8/22/93	23.00	23.20	0.422	0.0674	1.31	1.75	2.28	NA	1.03	5.06	6.8594	1.27	3.3	0.823	< 10.0
82 I-38	8/22/93	23.20	23.40	0.315	0.0188	0.121	0.154	0.0592	NA	0.129	0.3422	0.797	0.031	0.113	0.031	< 10.0
82 I-37	8/22/93	23.40	23.76	0.712	0.182	2.72	3.96	7.86	NA	4.79	16.61	20.224	2.32	5.38	1.5	340
82 I-36	8/22/93	23.76	24.12	0.0812	0.0154	0.0238	0.0364	0.0898	NA	0.085	0.2112	0.3316	0.0121	17.2	0.00937	< 10.0
82 I-35	8/22/93	24.12	24.48	0.00831	0.0137	BLQ1	BLQ1	< 0.01	NA	BLQ1	0	0.02201	BLQ1	BLQ1	< 0.01	< 10.0
82 I-34	8/22/93	24.48	24.84	< 0.01	0.0073	16.1	< 0.01	< 0.01	NA	< 0.01	0	16.1073	< 0.01	< 0.01	< 0.01	< 10.0
82 I-33	8/22/93	24.84	25.20	< 0.01	0.0122	27.1	< 0.01	< 0.01	NA	< 0.01	0	27.1122	BLQ1	BLQ1	< 0.01	< 10.0

TABLE 4.2 (Concluded)
FUEL HYDROCARBON COMPOUNDS DETECTED IN SOIL
UST SITE 870 INTRINSIC REMEDATION EE/CA
HILL AFB, UTAH

Sample Location	Sample Date	Sample Interval Top (ft bgs)	Sample Interval Bottom (ft bgs)	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	P-Xylene (mg/kg)	M-Xylene (mg/kg)	M&P-Xylene (mg/kg)	O-Xylene (mg/kg)	Total Xylenes (mg/kg)	Total BTEX (mg/kg)	1,3,5-TMB (mg/kg)	1,2,4-TMB (mg/kg)	1,2,3-TMB (mg/kg)	TPH (mg/kg)
82 I-32	8/22/93	25.20	25.56	0.0136	0.032	1.24	1.05	1.79	NA	0.0376	2.8776	4.1632	13.1	7.62	3.09	410(EST)
82 I-31	8/22/93	25.56	25.92	< 0.01	0.0114	0.101	< 0.01	0.0128	NA	BLQ1	0.0128	0.1252	0.418	0.0191	0.259	< 10.0
82 I-29	8/22/93	26.28	26.64	< 0.01	0.0157	BLQ1	BLQ1	BLQ1	NA	BLQ1	0	0.0157	BLQ1	BLQ1	BLQ1	NA
82 I-28	8/22/93	26.64	27.00	< 0.01	0.0168	BLQ1	BLQ1	0.00884	NA	BLQ1	0.00884	0.02564	BLQ1	0.00524	BLQ1	NA
82 I-30	8/22/93			< 0.01	0.0111	BLQ1	BLQ1	BLQ1	NA	BLQ1	0	0.0111	BLQ1	BLQ1	BLQ1	NA
MW-08	6/18/92	11.00	11.50	< 0.005	0.031	0.12	NA	NA	NA	NA	0.92	0.963	NA	NA	NA	110
MW-05	6/17/92	15.50	16.00	2	0.11	0.26	NA	NA	NA	NA	2.8	5.17	NA	NA	NA	20
MW-01	11/6/91	16.00	17.00	0.15	0.129	0.057	NA	NA	0.203	0.115	0.318	0.654	NA	NA	NA	< 10.0
MW-01A	6/29/92	17.00	17.50	10	23	16	NA	NA	NA	NA	74	123	NA	NA	NA	1500
MW-01		18.00	19.00	0.564	0.145	0.341	NA	NA	1.64	0.609	2.249	3.299	NA	NA	NA	98.3
MW-06	6/17/92	21.00	21.50	0.009	< 0.005	< 0.005	NA	NA	NA	NA	< 0.01	0.009	NA	NA	NA	< 10.0
MW-01A	7/1/92	59.50	60.00	< 0.005	< 0.005	< 0.005	NA	NA	NA	NA	< 0.01	0	NA	NA	NA	< 10.0
MW-09	6/29/92	17.00	17.50	0.1	0.1	0.18	NA	NA	NA	NA	5.4	5.78	NA	NA	NA	360
SB870A-03	11/7/91	11.00	12.00	9.4	115	66.7	NA	NA	494	140	634	2.214	NA	NA	NA	2790
SB870A-02	11/7/91	15.00	16.00	0.0432	0.0513	0.0522	NA	NA	0.365	0.0923	0.4573	0.6399	NA	NA	NA	23.2
SB870A-02	11/7/91	17.00	18.00	0.013	0.0602	0.0577	NA	NA	0.386	0.123	0.509	0.604	NA	NA	NA	37
SB870A-03	11/7/91	19.00	20.00	0.338	0.595	0.138	NA	NA	0.867	0.276	1.143	825.1	NA	NA	NA	< 10.0
SB870A-03 d	11/7/91	19.00	20.00	22.2	187	83.1	NA	NA	567	177	744	1036.3	NA	NA	NA	15100

* All samples with an 82 prefix are from EPA-82 series wells
See Appendix C for analytical methods
BLQ1 = Detected Below Limit of Quantification of 0.01 μg/mL
NA = Sample not analyzed for this parameter
EST = Estimated value reported by lab
NSN = No sample number
d = Duplicate sample



LEGEND

- ▲ CONE PENETROMETER TEST POINT/ PIEZOMETER
- MW-11 ● MONITORING WELL LOCATION
- ● AUGUST 1993 GEOPROBE SAMPLING LOCATION
- □ STORM DRAIN SURVEY LOCATION
- ■ JULY 1994 GEOPROBE SAMPLING LOCATION
- ◆ JULY 1994 SOIL BORING LOCATION
- —1.00— LINE OF EQUAL BTEX CONCENTRATION (mg/kg) DRAWN AT INTERNAL OF GREATEST CONCENTRATION
- ND NOT DETECTED (<0.01 mg/kg)

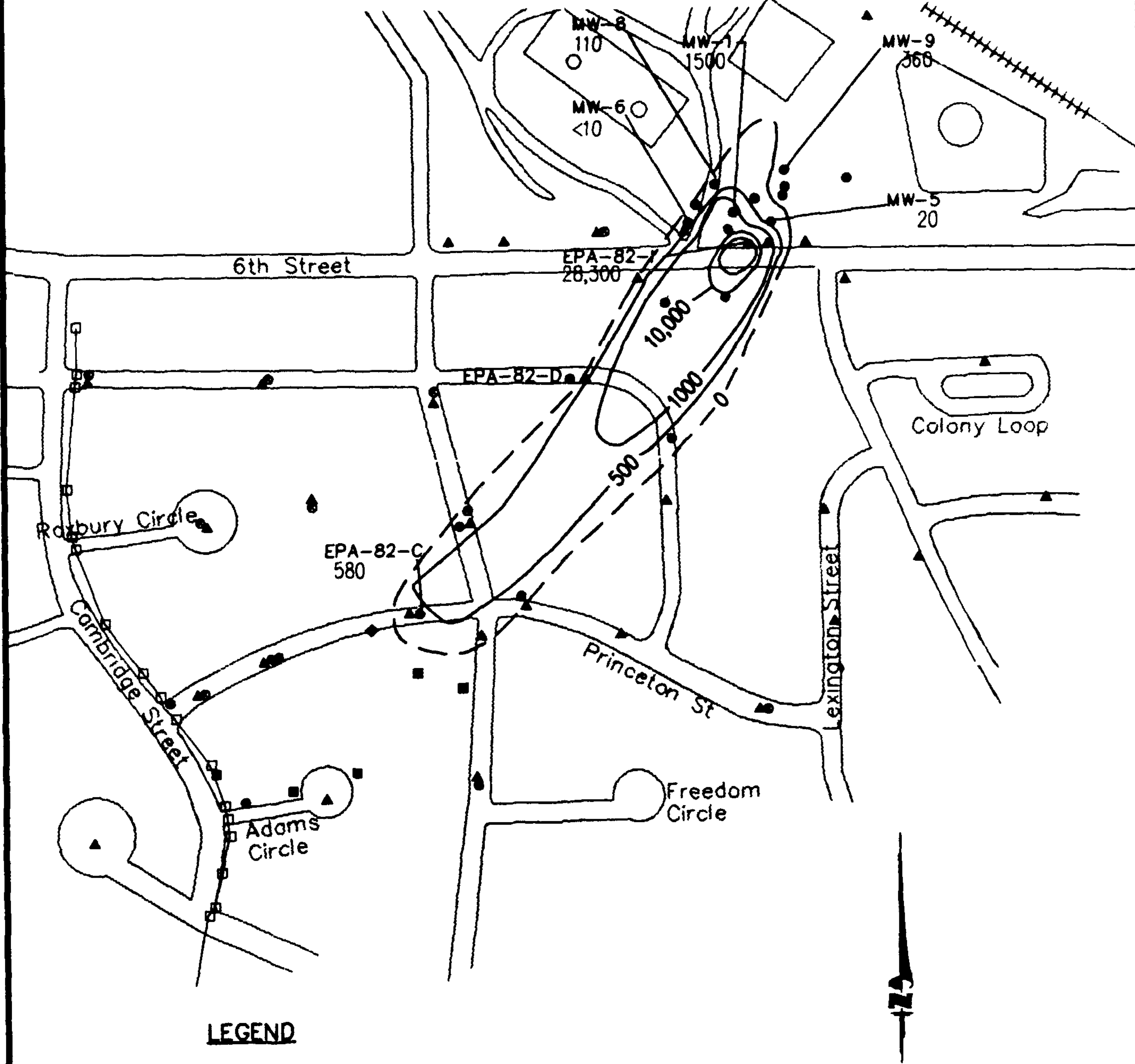
CONTOUR INTERVAL = VARIABLE

FIGURE 4.2

TOTAL BTEX ISOPLETH FOR SOIL

UST Site 870
Intrinsic Remediation EE/CA
Hill Air Force Base, Utah

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado



LEGEND

CPT-26 ▲ CONE PENETROMETER TEST POINT/ PIEZOMETER

MW-11 ● MONITORING WELL LOCATION

● AUGUST 1993 GEOPROBE SAMPLING LOCATION

□ STORM DRAIN SURVEY LOCATION

EPA-82-M ■ JULY 1994 GEOPROBE SAMPLING LOCATION

EPA-82-KK ◆ JULY 1994 SOIL BORING LOCATION

—500— LINE OF EQUAL TOTAL PETROLEUM HYDROCARBON CONCENTRATION (mg/kg) (DASHED WHERE INFERRED)

FIGURE 4.3

TOTAL PETROLEUM HYDROCARBON ISOPLETH MAP FOR SOIL

UST Site 870
Intrinsic Remediation EE/CA
Hill Air Force Base, Utah

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

contamination at concentrations above 100 mg/kg in the soil is approximately 7 feet at EPA-82-I, which is in the vicinity of the initial fuel release into the soil. This 7-foot-thick zone of elevated TPH concentrations extends above and below the ground water table. Downgradient areas with residual-phase contamination have TPH levels as high as 580 mg/kg, but the contaminated zones are less than 1 foot thick. Theoretically, because BTEX is a subset of TPH, the areas of BTEX and TPH contamination should be the same. However, because of the higher detection limit associated with the TPH analytical method, the area of detected TPH is slightly smaller than the area with elevated BTEX concentrations at this site.

4.2.3 Total Organic Carbon

TOC concentrations are used to estimate the amount of organic matter sorbed on soil particles or trapped in the interstitial passages of a soil matrix. The TOC concentration in the saturated zone is an important parameter used to estimate the amount of contaminant that could potentially be sorbed to the aquifer matrix. Sorption results in slowing (retardation) of the contaminant plume relative to the average advective ground water velocity. Background measurements of TOC were taken from core samples obtained from soil boring EPA-82-E. The TOC in the soil at this point ranges from 0.069 to 0.094 percent (Table 4.3).

TABLE 4.3

TOTAL ORGANIC CARBON IN SOIL
UST SITE 870 INTRINSIC REMEDATION EE/CA
HILL AFB, UTAH

Sample Location	Soil Filtrate (% OC)	Solids (% OC)	Total Soil (% OC)	Mean + 1 Standard Deviation Soil % TOC
82E-12-1 (6.65 - 7.00 feet bgs[a])	0.007	0.046	0.053	
82E-12-2 (6.65 - 7.00 feet bgs)	0.009	0.056	0.065	0.069+0.019
82E-12-3 (6.65 - 7.00 feet bgs)	0.007	0.083	0.09	
82E-14-1 (5.95 - 6.30 feet bgs)	0.007	0.074	0.081	
82E-14-2 (5.95 - 6.30 feet bgs)	0.006	0.062	0.068	0.070+0.011
82E-14-3 (5.95 - 6.30 feet bgs)	0.006	0.054	0.06	
82E-15-1 (5.60 - 5.95 feet bgs)	0.014	0.071	0.085	
82E-15-2 (5.60 - 5.95 feet bgs)	0.018	0.074	0.092	0.087+0.004
82E-15-3 (5.60 - 5.95 feet bgs)	0.012	0.073	0.085	
82E-17-1 (4.90 - 5.25 feet bgs)	0.011	0.101	0.112	
82E-17-2 (4.90 - 5.25 feet bgs)	0.011	0.078	0.089	0.094+0.017
82E-17-3 (4.90 - 5.25 feet bgs)	0.012	0.068	0.08	
LECO STANDARD DEVIATION SOIL		1.022		
		1.034		
LECO STANDARD DEVIATION SOIL T.V.		1.00+0.04		

[a] feet bgs = feet below ground surface.

Soil TOC samples were collected just below the phreatic surface for accurate estimates of TOC in the shallow saturated zone. EPA-82-E was selected as a TOC sampling location because it was located outside of mobile or residual LNAPL contaminated soils (which would compromise TOC readings) and directly downgradient of potential plume migration. As a result, the soil TOC at EPA-82-E is indicative of the potential sorptive potential in the shallow aquifer directly downgradient of anticipated plume migration. The TOC estimate compares favorably with literature values defining TOC contents in relatively clean, sandy soils (0.01 percent TOC).

4.3 GROUND WATER CHEMISTRY

4.3.1 Dissolved-Phase BTEX Contamination

Laboratory analytical results for ground water samples collected during previous site investigations indicated the presence of fuel-hydrocarbon contamination in the shallow saturated zone in the vicinity of UST Site 870. Ground water samples collected in August 1993 by Parsons ES and RSKERL personnel confirmed these results. Additional ground water samples collected in July 1994 suggest that natural attenuation of BTEX compounds is occurring at this site. Table 4.4 summarizes available ground water contaminant data. Two ground water samples from the site appear to have unrealistically high total BTEX concentrations ranging from 52.7 mg/L (TP-07 = CPT-07) to 14,400 mg/L (CPT-14). The work of Smith *et al.* (1981) suggests that the maximum dissolved-phase BTEX concentration that can result from the equilibrium partitioning of BTEX compounds from JP-4 into ground water is approximately 30 mg/L. Unrealistically high total BTEX concentrations generally result from LNAPL emulsification during sampling. The highest dissolved-phase total BTEX concentration observed at the site that can be considered reliable is 26,576 µg/L. This sample was collected from well MW-03 in August, 1992. This well contained mobile LNAPL but this total BTEX concentration is within the range suggested by Smith *et al.* (1981) and is consistent with samples collected from other wells containing mobile LNAPL (EPA-82-I = 21,475 µg/L and EPA-82-J = 16,336 µg/L).

To evaluate trends in BTEX loss over the site, data sets from different sampling periods were combined to form BTEX isopleth maps for 1993 and 1994 (described in proceeding paragraphs). Although generally not a concern, the various ground water analytical methods used to sample ground water from different site characterization studies (1992 to 1994) were judged for their

TABLE 4.4
FUEL HYDROCARBON COMPOUNDS DETECTED IN GROUND WATER
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

Sample Location	Sample Date	Easting	Northing	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	P-Xylene (µg/L)	M-Xylene (µg/L)	M&P-Xylene (µg/L)	O-Xylene (µg/L)	Total Xylenes (µg/L)	Total BTEX (µg/L)	1,3,5-TMB (µg/L)	1,2,4-TMB (µg/L)	1,2,3-TMB (µg/L)
MONITORING WELL SAMPLING LOCATIONS															
EPA-82-A	8/19/93	1546.62	2945.1	<1	<1	<1	<1	<1	NA	<1	<1	<1	<1	<1	<1
EPA-82-A	11/8/93	1546.62	2945.1	<1	BLQ1	<1	<1	<1	NA	<1	<1	BLQ1	1.14	0.965	BLQ1
EPA-82-A	7/94	1546.62	2945.1	<1	<1	<1	<1	<1	NA	<1	<1	<1	<1	<1	<1
EPA-82-B	8/20/93	2062.23	3063.44	<1	4.29	<1	<1	<1	NA	<1	<1	4.29	1.06	1.43	<1
EPA-82-B	11/8/93	2062.23	3063.44	<1	<1	<1	<1	<1	NA	<1	<1	<1	<1	<1	<1
EPA-82-B d	11/8/93	2062.23	3063.44	<1	<1	<1	<1	<1	NA	<1	<1	<1	<1	<1	<1
EPA-82-B d	7/94	2062.23	3063.44	<1	<1	<1	<1	<1	NA	<1	<1	<1	<1	<1	<1
EPA-82-C	8/20/93	1840.49	3035.78	4.92	3.13	26.5	42.8	47.2	NA	2.62	92.62	127.17	238	324	120
EPA-82-C	11/9/93	1840.49	3035.78	<1	6.38	6.81	20.2	6.38	NA	1.82	28.4	41.59	79.7	68.9	64.1
EPA-82-C	7/94	1840.49	3035.78	7.28	9.74	22.7	25.9	18.3	NA	3.18	47.38	87.1	144	143	42.9
EPA-82-D	8/21/93	2167.57	3507.69	95.8	10.4	147	149	383	NA	103	635	888.2	129	183	88.8
EPA-82-D	11/9/93	2167.57	3507.69	174	4.64	30.8	141	293	NA	57.5	491.5	700.94	89.4	119	77.1
EPA-82-D	7/94	2167.57	3507.69	458	9.71	454	272	442	NA	50.7	764.7	1686.41	125	176	60.4
EPA-82-E	8/22/93	1345.36	2845.36	<1	<1	<1	<1	<1	NA	<1	<1	<1	<1	<1	<1
EPA-82-E	11/8/93	1345.36	2845.36	<1	<1	<1	<1	<1	NA	<1	<1	<1	<1	<1	<1
EPA-82-E	7/94	1345.36	2845.36	<1	<1	<1	<1	<1	NA	<1	<1	<1	<1	<1	<1
EPA-82-F	8/21/93	1543.19	2943.57	<1	<1	<1	<1	<1	NA	<1	<1	<1	<1	<1	<1
EPA-82-F	11/9/93	1543.19	2943.57	<1	<1	<1	<1	<1	NA	<1	<1	<1	<1	<1	<1
EPA-82-F	7/94	1543.19	2943.57	ND	ND	<1	<1	<1	NA	ND	<1	<1	ND	<1	ND
EPA-82-F d	7/94	1543.19	2943.57	ND	ND	ND	<1	<1	NA	ND	<1	<1	ND	<1	ND
EPA-82-H	8/21/93	1964.51	2719.71	<1	<1	<1	<1	<1	NA	<1	<1	<1	<1	<1	<1
EPA-82-H	11/8/93	1964.51	2719.71	<1	<1	<1	<1	<1	NA	<1	<1	<1	0.942	BLQ1	BLQ1
EPA-82-H	7/94	1964.51	2719.71	<1	<1	<1	<1	<1	NA	ND	<1	<1	ND	<1	ND
EPA-82-I (a)	11/93	2520.42	3771.26	2740	372	486	784	1370	NA	1140	3294	6892	162	495	240
EPA-82-I	7/94	2520.42	3771.26	5600	5870	955	1620	5130	NA	2300	9050	21475	417	1270	436
EPA-82-J	7/94	NA	NA	4260	3910	816	1370	4220	NA	1760	7350	16336	485	1310	515
MW-01	11/18/91	2475.32	3841.98	305	690	132	NA	NA	NA	NA	2283	3410	NA	NA	NA
MW-01	12/93-1/94	2475.32	3841.98	475	88	183	NA	NA	NA	NA	1160	1906	330	680	NA
MW-02	12/93-1/94	2389.21	3846.24	51	56.3	73.3	NA	NA	NA	NA	776	956.6	350	750	NA
MW-03	08/6/92	2533.09	3882.19	12179	6728	<5	NA	NA	4300	3369	7669	26576	NA	NA	NA
MW-03	10/92	2533.09	3882.19	12.18	6.73	<1	NA	NA	NA	NA	7.67	26.58	NA	NA	NA
MW-03	12/93-1/94	2533.09	3882.19	2320	1300	376	NA	NA	NA	NA	5470	9466	480	1000	NA
MW-04	12/93-1/94	2446.7	3798.05	930	1830	450	NA	NA	NA	NA	5120	8330	550	1500	NA
MW-05	09/30/92	2536.47	3813.49	74	<50	160	NA	NA	NA	NA	900	1134	NA	NA	NA
MW-05 d	09/30/92	2536.47	3813.49	76	<50	150	NA	NA	NA	NA	890	1116	NA	NA	NA
MW-05	12/93-1/94	2536.47	3813.49	416	250	246	NA	NA	NA	NA	2508	3420	450	960	NA
MW-06	9/92	2389.06	3794.35	<25	<25	<25	NA	NA	NA	NA	<25	<25	NA	NA	NA
MW-06	09/04/92	2389.06	3794.35	<25	<25	<25	NA	NA	NA	NA	<25	<25	NA	NA	NA
MW-06	12/93-1/94	2389.06	3794.35	24.5	10.1	18.6	NA	NA	NA	NA	155.9	209.1	650	1500	NA

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TABLE 4.4 (Continued)
FUEL HYDROCARBON COMPOUNDS DETECTED IN GROUND WATER
UST SITE 870 INTRINSIC REMEDATION EE/CA
HILL AFB, UTAH

Sample Location	Sample Date	Easting	Northing	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	P-Xylene (µg/L)	M-Xylene (µg/L)	M&P-Xylene (µg/L)	O-Xylene (µg/L)	Total Xylenes (µg/L)	Total BTEX (µg/L)	1,3,5-TMB (µg/L)	1,2,4-TMB (µg/L)	1,2,3-TMB (µg/L)
MW-07	9/92	2621.27	3900.79	<5	<5	<5	NA	NA	NA	NA	<5	<5	NA	NA	NA
MW-07 (TWP-3)	09/07/92	2621.27	3900.79	<5	<5	<5	NA	NA	NA	NA	<5	<5	NA	NA	NA
MW-07 d	09/07/92	2621.27	3900.79	<5	<5	<5	NA	NA	NA	NA	<5	<5	NA	NA	NA
MW-07	12/93-1/94	2621.27	3900.79	<1	<1	<1	NA	NA	NA	NA	<1	<1	<1	<1	NA
MW-08	12/93-1/94	2449.7	3893.96	18.6	10.8	29.3	NA	NA	NA	NA	314.4	373.1	140	280	NA
MW-09	12/93-1/94	2529.21	3930.05	72	27	35	NA	NA	NA	NA	558	692	150	650	NA
MW-10	10/92	2354.84	3397.6	1.16	0.57	0.06	NA	NA	NA	NA	0.27	2.06	NA	NA	NA
MW-10 d	10/92	2354.84	3397.6	<5	17	<0.5	NA	NA	NA	NA	110	127	NA	NA	NA
MW-10	10/01/92	2354.84	3397.6	<5	17	<5	NA	NA	NA	NA	110	127	NA	NA	NA
MW-10	8/18/93	2354.84	3397.6	<10	290	443	401	2470	NA	1280	4151	4884	575	828	607
MW-10 d	8/18/93	2354.84	3397.6	<2	340	543	471	2880	NA	1490	4841	5724	713	974	683
MW-10	11/9/93	2354.84	3397.6	7.44	62.9	190	189	1090	NA	505	1784	2044.34	174	297	212
MW-10	7/94			20	54.7	182	190	847	NA	441	1478	1734.7	215	303	197
MW-11	09/30/92	1923.08	3213.91	26	33	21	NA	NA	NA	NA	180	260	NA	NA	NA
MW-11	8/18/93	1923.08	3213.91	336	90.3	139	230	635	NA	204	1069	1634.3	71.8	165	69.3
MW-11	9/93	1923.08	3213.91	26	33	21	NA	NA	NA	NA	180	260	NA	NA	NA
MW-11	11/9/93	1923.08	3213.91	105	46.5	39.9	65	221	NA	86.4	372.4	563.8	30	55.7	28.7
MW-11	7/94			ND	ND	<1	<1	<1	NA	<1	<1	<1	<1	<1	<1
MW-12	10/92	2457.72	3650.34	<5	<5	29	NA	NA	NA	NA	300	329	NA	NA	NA
MW-12	10/01/92	2457.72	3650.34	10	<5	29	NA	NA	NA	NA	300	339	NA	NA	NA
MW-12	7/94			<1	<1	0.9	7.82	9.45	NA	17.3	34.57	35.47	9.89	36.2	13.3
MW-13	12/93-1/94	SDNA	SDNA	2690	1570	589	NA	NA	NA	NA	4280	9129	470	1113	NA
MW-14	12/93-1/94	SDNA	SDNA	941	2800	505	NA	NA	NA	NA	5510	9756	650	1400	NA
GEOPROBE SAMPLING LOCATIONS															
71-8 CPT (depth 1)		2547.88	3772.45	<1	BLQI	<1	<1	<1	NA	2.2	2.2	2.2	<1	<1	<1
71-17 CPT (depth 1)	8/3/93	1528.38	3493.12	<1	<1	<1	<1	<1	NA	<1	<1	<1	<1	<1	<1
71-17 CPT (depth 2)	8/3/93	1528.38	3493.12	<1	<1	<1	<1	<1	NA	<1	<1	<1	<1	<1	<1
71-18 CPT (depth 1)	8/3/93	1885.05	3457.77	<1	1.27	<1	<1	BLQI	NA	<1	BLQI	1.27	<1	1.1	1.08
71-18 CPT (depth 2)	8/3/93	1885.05	3457.77	<1	<1	<1	<1	<1	NA	<1	<1	<1	<1	<1	<1
71-19 CPT (depth 1)	8/2/93	1948.46	3215.91	51.4	BLQI	461	869	2730	NA	984	4583	5095.4	295	735	330
71-19 CPT (depth 1)d	8/2/93	1948.46	3215.91	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
71-23 CPT (depth 1)	8/5/93	2526.12	2835.21	<1	BLQI	<1	<1	<1	NA	<1	<1	<1	<1	<1	<1
71-29 CPT (depth 1)	8/2/93	1400.23	2863.23	<1	<1	<1	<1	<1	NA	<1	<1	<1	<1	<1	<1
71-29 CPT (depth 2)	8/2/93	1400.23	2863.23	<1	<1	<1	<1	<1	NA	<1	<1	<1	<1	<1	<1
71-31 CPT (depth 1)	8/3/93	1418.19	3205.92	<1	<1	<1	<1	<1	NA	<1	<1	<1	<1	<1	<1
71-31 CPT (depth 1)	8/3/93	1418.19	3205.92	<1	<1	<1	<1	<1	NA	<1	<1	<1	<1	<1	<1
71-31 CPT (depth 2)	8/3/93	1418.19	3205.92	<1	<1	<1	<1	<1	NA	<1	<1	<1	<1	<1	<1

TABLE 4.4 (Continued)
FUEL HYDROCARBON COMPOUNDS DETECTED IN GROUND WATER
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

Sample Location	Sample Date	Easting	Northing	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	P-Xylene (µg/L)	M-Xylene (µg/L)	M&P-Xylene (µg/L)	O-Xylene (µg/L)	Total Xylenes (µg/L)	Total BTEX (µg/L)	1,3,5-TMB (µg/L)	1,2,4-TMB (µg/L)	1,2,3-TMB (µg/L)
71-39 CPT (depth 1)	8/5/93	2758.65	4145.21	<1	<1	<1	<1	<1	NA	<1	<1	<1	<1	<1	<1
71-39 CPT (depth 2)	8/5/93	2758.65	4145.21	<1	<1	<1	<1	<1	NA	<1	<1	<1	<1	<1	<1
71-39 CPT (depth 2)d	8/5/93	2758.65	4145.21	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
EPA-82-K	7/94	1458.62	2656.22	<1	<1	<1	<1	<1	NA	<1	<1	<1	ND	<1	ND
EPA-82-L1	7/94	-8055.75	2834.32	6	18.1	103	379	572	NA	604	1555	1682.1	396	433	223
EPA-82-L2	7/94	-8055.75	2834.32	4.01	18.8	9.72	23.8	49.2	NA	35.8	108.8	141.33	22	28.6	15.2
EPA-82-L3	7/94	-8055.75	2834.32	1.44	7.19	4	8.53	20.2	NA	12.9	41.63	54.26	7.43	[illegible]	8.88
EPA-82-M	7/94	1700.5	2698.09	<1	3	1.58	2.89	7.59	NA	4.95	15.43	20.01	2.33	[illegible]	3.06
EPA-82-M d	7/94	1700.5	2698.09	<1	3.1	1.5	2.77	7.63	NA	5.1	15.5	20.1	2.23	[illegible]	2.93
EPA-82-N	7/94	1425.23	2738.09	<1	<1	<1	<1	<1	NA	<1	<1	<1	ND	<1	<1
EPA-82-O	7/94	1594.5	2688.82		<1	<1	<1	<1	NA	<1	<1	<1	ND	<1	<1
EPA-82-P	7/94	1776.37	2865.35	<1	<1	3.5	11.5	18.8	NA	5.99	36.29	39.79	77.7	159	57.9
CONE PENETROMETER SAMPLING LOCATIONS															
CPT-07	08/07/92	2547.88	3772.45	<500	<500	1800	NA	NA	4600	1900	6500	8300	NA	NA	NA
CPT-07	09/30/92	2547.88	3772.45	680	34(EST)	1400	NA	NA	NA	NA	5700	7814	NA	NA	NA
CPT-10	10/19/92	2602.28	3772.04	<5	11	16	NA	NA	NA	NA	160	187	NA	NA	NA
CPT-14	12/18/92	2182.6	3507.6	<250,000	<250,000	1400000	NA	NA	NA	NA	13000000	14400000	NA	NA	NA
CPT-40	11/24/92	2758.65	4145.21	<1	<1	<1	NA	NA	<1	<1	<1	<1	NA	NA	NA
CPT-42	11/24/93	3067.32	3238.57	<1	<1	<1	NA	NA	[illegible]	<1	<1	<1	NA	NA	NA
CPT-42	11/30/92	3067.32	3238.57	<1	<1	<1	NA	NA	[illegible]	<1	<1	<1	NA	NA	NA
CPT-43	11/24/93	2683.44	3014.06	<1	<1	<1	NA	NA	[illegible]	<1	<1	<1	NA	NA	NA
CPT-43	11/30/92	2683.44	3014.06	<1	<1	<1	NA	NA	<1	<1	<1	<1	NA	NA	NA
TP-01	08/5/92	SDNA	SDNA	741	2273	<5	NA	NA	540	487	1027	4041	NA	NA	NA
TP-02	08/5/92	SDNA	SDNA	5203	7578	740	NA	NA	1903	2274	4177	17698	NA	NA	NA
TP-03	08/10/92	SDNA	SDNA	2701	3112	322	NA	NA	801	854	1655	7790	NA	NA	NA
TP-07	08/5/92	2547.88	3772.45	26092	21919	753	NA	NA	1459	2447	3906	52670	NA	NA	NA
TP-09	08/6/92	SDNA	SDNA	992	2128	173	NA	NA	211	90	301	3594	NA	NA	NA
TP-10	08/6/92	2602.28	3772.04	1928	3214	<5	NA	NA	1854	1976	3830	8972	NA	NA	NA
TP-12	08/7/92	2354.84	3397.6	1163	565	62	NA	NA	215	50	265	2055	NA	NA	NA
TP-13	08/7/92	2062.91	3060.14	<5	69	<5	NA	NA	62	<5	62	131	NA	NA	NA
TP-14	08/7/92	2182.6	3507.6	1440	392	338	NA	NA	930	448	1378	3548	NA	NA	NA
TP-17	08/8/92	1528.38	3493.12	<5	<5	14	NA	NA	57	<5	57	71	NA	NA	NA
TP-19	08/8/92	1948.46	3215.91	646	<5	36	NA	NA	149	<5	149	831	NA	NA	NA
TP-20	08/8/92	1848.28	3037.59	124	2699	<5	NA	NA	<5	504	504	3327	NA	NA	NA
TP-21	08/8/92	2349.56	3244.25	<5	<5	<5	NA	NA	57	<5	57	57	NA	NA	NA
TP-22	08/9/92	SDNA	SDNA	56	90	22	NA	NA	68	36	104	272	NA	NA	NA
TP-36	08/13/92	2670.91	3231.11	<5	<5	<5	NA	NA	52	<5	52	52	NA	NA	NA
TP-37	08/13/92	1970.3	2978.15	789	930	<5	NA	NA	2410	1769	4179	5898	NA	NA	NA
TWP-01	08/12/92	SDNA	SDNA	520	1271	85	NA	NA	141	32	173	2049	NA	NA	NA

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TABLE 4.4 (Concluded)
FUEL HYDROCARBON COMPOUNDS DETECTED IN GROUND WATER
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

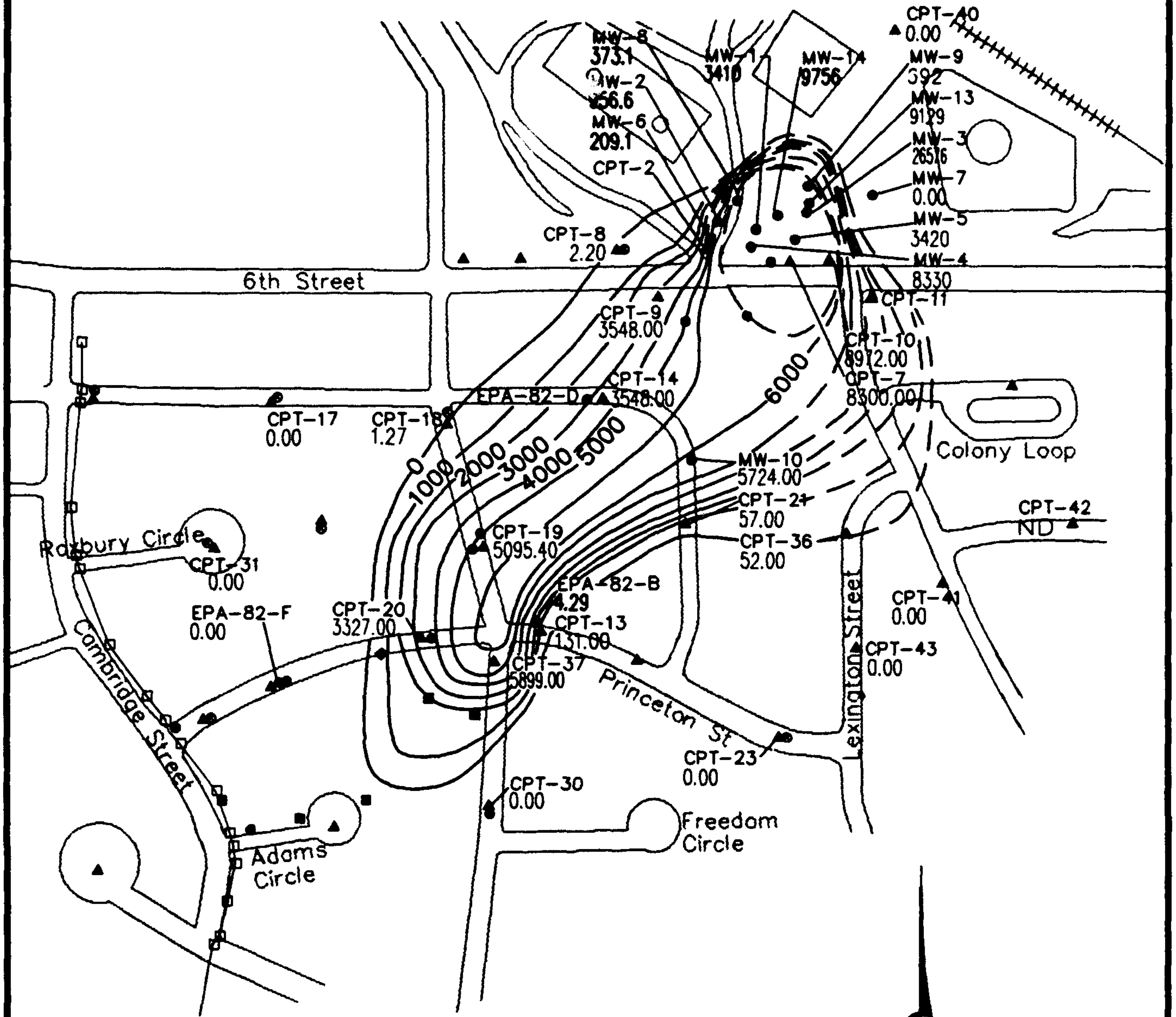
Sample Location	Sample Date	Easting	Northing	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	P-Xylene (µg/L)	M-Xylene (µg/L)	M&P-Xylene (µg/L)	O-Xylene (µg/L)	Total Xylenes (µg/L)	Total BTEX (µg/L)	1,3,5-TMB (µg/L)	1,2,4-TMB (µg/L)	1,2,3-TMB (µg/L)
STORM SEWER SAMPLING LOCATIONS															
STORM-2	8/93	1430.1	2443.98	<1	<1	<1	<1	<1	NA	<1	<1	<1	<1	<1	<1
STORM-3	8/93	1445.12	2511.52	<1	<1	<1	<1	<1	NA	<1	<1	<1	<1	<1	<1
MISCELLANEOUS SAMPLING LOCATIONS															
870-WS-1/32'	11/23/92	SDNA	SDNA	17.4	1.8	BLQ1	NA	NA	4.9	1.3	6.2	25.4	NA	NA	NA
870-WS-1/42'	11/23/92	SDNA	SDNA	30.5	113	56.4	NA	NA	369	103	472	671.9	NA	NA	NA
870-WS-1/52'	11/24/92	SDNA	SDNA	27	59.3	21.6	NA	NA	107	36.4	143.4	251.3	NA	NA	NA
870-WS-2/49 d	11/24/92	SDNA	SDNA	6.5	7.8	1.7	NA	NA	12.2	3.4	15.6	31.6	NA	NA	NA
870-WS-2/49'	11/24/92	SDNA	SDNA	8.4	13.8	4.5	NA	NA	30.2	9.4	39.6	66.3	NA	NA	NA
870-WS-2/59'	11/24/92	SDNA	SDNA	24	68	50.7	NA	NA	294	93.7	387.7	530.4	NA	NA	NA
870-WS-2/69'	11/24/92	SDNA	SDNA	43.5	71.7	38.2	NA	NA	258	63.6	321.6	475	NA	NA	NA
GWS-01	08/14/92	SDNA	SDNA	195	946	72	NA	NA	62	27	89	1302	NA	NA	NA
SGS-01	08/05/92	SDNA	SDNA	161	12645	46	NA	NA	<5	295	295	13147	NA	NA	NA
SGS-1	08/07/92	SDNA	SDNA	7.7	<5	5.5	NA	NA	8.8	19	27.8	41	NA	NA	NA

See Appendix C for analytical methods
(a)=Headspace data
d = Sample duplicate
BLQ1=Detected below Limit of Quantification of 1 µg/L
BLQ2=Detected below Limit of Quantification of 4 µg/L
BLQ3=Detected below Limit of Quantification of 2 µg/L
BLQ4=Detected below Limit of Quantification of 10 µg/L
NA = Sample not analyzed for this parameter
EST = Estimated value reported by lab
SDNA=Surveyor's data not available

quantitative comparability. Method RSKOP-124 was used by Parsons ES to quantitate aqueous BTEX concentrations during August 1993 and 1994 sampling events. RSKOP-124 is a dual-column, gas-chromatograph/mass spectroscopy (GC/MS) technique that has resolution capabilities that are superior to EPA SW-846 Methods 8020/602, 8015M, and 8240 (used for volatile and semi-volatile organic analysis by JMM in 1992). All analytical techniques used for VOC analysis in the different site characterization studies from 1992 to 1994 had identical, achievable detection limits of 1 μg/L and adequate compound resolution capabilities. Hence, comparison of different ground water data sets are not compromised by underestimation or overestimation of a particular analytical technique. Groundwater extraction and preparation techniques used by JMM in 1992 are not available; however, potential differences in sampling technique were predicted to be minor because ground water sampling techniques are fairly standardized.

Figure 4.4 is an isopleth map that shows the distribution of total BTEX dissolved in ground water through August 1993. Because this figure was used for Bioplume II model input (to be conservative) the highest total BTEX concentrations observed in ground water between August 1992 and August 1993 were used to prepare this figure. This figure also includes data collected from monitoring wells in the source area north of Sixth Street in December 1993/January 1994 (MW-01, MW-02, and MW-04 through MW-09). These wells cover a very small area relative to the areal extent of the plume and in some cases these data represent the only data available for this area. As a result, Figure 4.4 represents the most conservative representation of the 1993 BTEX plume based on available data. BTEX contamination is migrating to the southwest in the direction of ground water flow. During the period through August 1993, the BTEX plume was approximately 1,650 feet long and 750 feet wide at the widest point.

Figure 4.5 is an isopleth map that shows the distribution of total BTEX dissolved in ground water in July 1994. Like Figure 4.4, this figure also includes data collected from monitoring wells in the source area in December 1993/January 1994 (MW-01 through MW-09) to illustrate the BTEX plume for 1994. Comparison of Figures 4.4 and 4.5 suggests that a reduction in the areal extent of the BTEX plume occurred between September 1992/August 1993 and July 1994. With the exception of total BTEX concentrations in some of the monitoring wells located in the area containing mobile LNAPL (wells MW-05, MW-06, EPA-82-D), dissolved-phase total BTEX concentrations were seen to decline over this period. The increased concentrations in these wells could be the result of a fresh spill in the source area. Figure 4.4 shows that through



0 0 150 300 600

FEET

LEGEND

CPT-26 ▲	CONE PENETROMETER TEST POINT/ PIEZOMETER
MW-11 ●	MONITORING WELL LOCATION
●	AUGUST 1993 GEOPROBE SAMPLING LOCATION
□	STORM DRAIN SURVEY LOCATION
EPA-82-M ■	JULY 1994 GEOPROBE SAMPLING LOCATION
EPA-82-KK ◆	JULY 1994 SOIL BORING LOCATION
—1000—	LINE OF EQUAL TOTAL BTEX CONCENTRATION (μg/L) (HIGHEST LEVELS FROM AUGUST 1992 THROUGH AUGUST 1993
ND	NOT DETECTED
	CONTOUR INTERVAL = 1000 mg/L

FIGURE 4.4

TOTAL BTEX ISOPLETH FOR GROUNDWATER THROUGH AUGUST 1993

UST Site 870
Intrinsic Remediation EE/CA
Hill Air Force Base, Utah

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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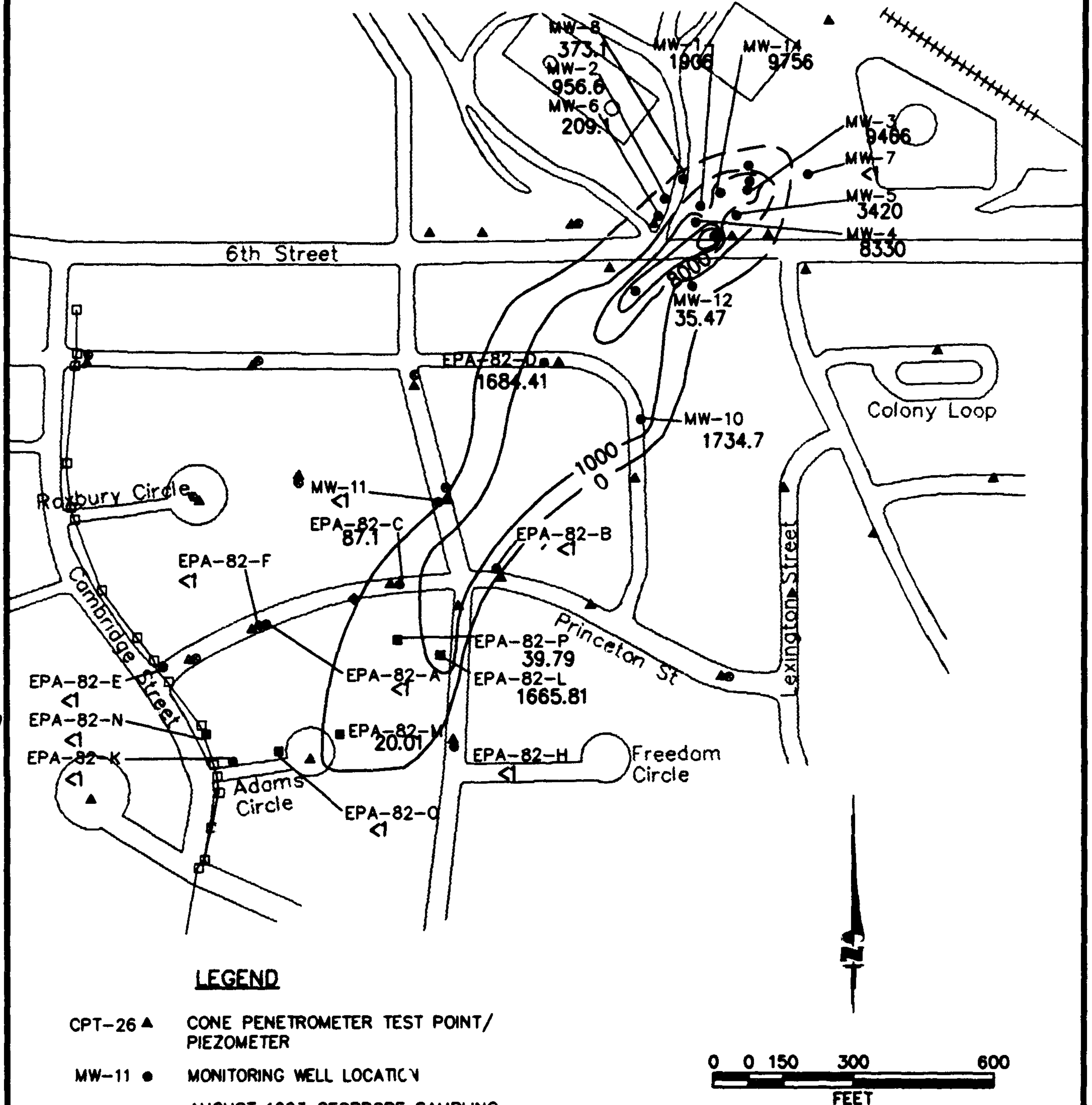

LEGEND

CPT-26 ▲	CONE PENETROMETER TEST POINT/ PIEZOMETER
MW-11 ●	MONITORING WELL LOCATION
●	AUGUST 1993 GEOPROBE SAMPLING LOCATION
□	STORM DRAIN SURVEY LOCATION
EPA-82-M ■	JULY 1994 GEOPROBE SAMPLING LOCATION
EPA-82-KK ◆	JULY 1994 SOIL BORING LOCATION
—1000—	LINE OF EQUAL BTEX CONCENTRATION (ug/L) (DASHED WHERE INFERRED)

CONTOUR INTERVAL = VARIABLE

FIGURE 4.5

TOTAL BTEX ISOPLETH FOR GROUNDWATER JULY 1994

UST Site 870
Intrinsic Remediation EE/CA
Hill Air Force Base, Utah

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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BTEX_1994

August 1993, the majority of the dissolved-phase BTEX plume had concentrations in excess of 5,000 micrograms per liter (µg/L), whereas Figure 4.5 shows that in July 1994, the majority of the dissolved-phase BTEX plume had concentrations below 2,000 µg/L. Because Figure 4.4 was prepared with the highest BTEX concentrations observed between August 1992 and August 1993, comparison of these two figures may suggest rates of intrinsic remediation that are somewhat high. Available geochemical data suggest that this reduction in the areal extent and concentration of the total BTEX plume was primarily the result of biodegradation, as discussed in the following sections.

4.3.2 Inorganic Chemistry and Geochemical Indicators of Biodegradation

Microorganisms obtain energy for cell production and maintenance by catalyzing the transfer of electrons from electron donors to electron acceptors. This results in the oxidation of the electron donor and the reduction of the electron acceptor. Electron donors at UST Site 870 are natural organic carbon and fuel hydrocarbon compounds. Fuel hydrocarbons are completely degraded or detoxified if they are utilized as the primary electron donor for microbial metabolism (Bouwer, 1992). Electron acceptors are elements or compounds that occur in relatively oxidized states and include oxygen, nitrate, ferrous iron, sulfate, and carbon dioxide. Microorganisms preferentially utilize electron acceptors while metabolizing fuel hydrocarbon (Bouwer, 1992). Dissolved oxygen is utilized first as the prime electron acceptor. After the DO is consumed, anaerobic microorganisms use electron acceptors in the following order of preference: nitrate, ferrous iron, sulfate, and finally carbon dioxide. Anaerobic destruction of the BTEX compounds is associated with the accumulation of fatty acids, production of methane, solubilization of iron, and reduction of nitrate and sulfate (Cozzarelli *et al.*, 1990; Wilson *et al.*, 1990).

4.3.2.1 Dissolved Oxygen

DO concentrations were measured at Geoprobe® locations and monitoring points/wells in August 1993, November 1993, December 1993/January 1994, and July 1994. Table 4.5 summarizes DO concentrations. Figure 4.6 is an isopleth map showing the distribution of DO in ground water in August 1993. This figure includes data collected from monitoring wells in the source area north of Sixth Street in December 1993/January 1994. These wells cover a small area and these data represent the only data available for this area. Figure 4.7 is an isopleth map showing the distribution of DO in ground water in July 1994. This figure also includes data collected from monitoring wells in the source area in December 1993/January 1994. Comparison

TABLE 4.5
GROUND WATER GEOCHEMICAL DATA
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

Sample Location	Sample Date	Water Temp. (°C)	Dissolved Oxygen (mg/L)	Redox Potential (mV)	Total Alkalinity (mg/L)	Conductivity (µS/cm)	pH	Chloride (mg/L)	Sulfate (mg/L)	Ferrous Iron (mg/L)	Ammonia (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	NO2+NO3 Nitrogen (mg/L)	Methane (mg/L)	TOC (mg/L)
MONITORING WELL SAMPLING LOCATIONS																
EPA-82-A	8/19/93	16.5	0.4	170	576	1677	7.2	170	66.4	<0.05	<0.05	NA	NA	0.14	0.001	4.2
EPA-82-A	11/8/93	14.8	0.3	NA	NA	NA	7.4	159	60.5	0.17	NA	NA	NA	0.08	0.001	2.2
EPA-82-A	7/7/94	16.3	<0.5	240	530	1622	7.2	156.0	58.6	<0.05	NA	NA	NA	<0.05	0.001	2.8
EPA-82-B	8/20/93	16.9	1	213	450	1421	6.9	163	76.9	<0.05	<0.05	NA	NA	0.25	0.001	2.1
EPA-82-B	11/8/93	12.9	1.2	NA	NA	NA	7.5	144	72.2	0.11	NA	NA	NA	0.37	<0.001	3.1
EPA-82-B	7/7/94	19.1	<0.5	125	428	1406	7.2	145.0	74.2	0.1	NA	NA	NA	0.15	0.001	2.2
EPA-82-C	8/20/93	15.5	0.5	-125	745	1828	6.9	164	49.9	2.1	<0.05	NA	NA	0.13	0.002	9.4
EPA-82-C duplicate	8/20/93	NA	NA	NA	NA	NA	NA	161	NA	NA	NA	NA	NA	NA	NA	9.5
EPA-82-C	11/9/93	14.2	0.4	NA	NA	NA	6.3	109	17.2	0.84	NA	NA	NA	0.08	0.002	6
EPA-82-D	8/21/93	15.9	1.3	40	959	2520	7.3	198	193 (EST)	0.4	0.07	NA	NA	0.53	<0.001	8.1
EPA-82-D duplicate	8/21/93	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.05	NA	NA	0.53	NA	NA
EPA-82-D	11/9/93	14.1	0.8	NA	NA	NA	7.2	151	116	1.7	NA	NA	NA	0.13	<0.001	5.2
EPA-82-D duplicate	11/9/93	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.3
EPA-82-D	7/7/94	17	<0.5	-138	657	1905	7.3	221.0	<0.5	7.4	NA	NA	NA	<0.05	0.002	10.3
EPA-82-E	8/22/93	22.8	5.6	192	349	1042	7.3	77.1	39.6	<0.05	<0.05	NA	NA	4.4	<0.001	1.7
EPA-82-E duplicate	8/22/93	NA	NA	NA	NA	NA	NA	78.3	39.8	NA	NA	NA	NA	NA	NA	NA
EPA-82-E	11/8/93	16.5	2.7	NA	NA	NA	7.4	76.4	65.8	0.02	NA	NA	NA	5.61	<0.001	1.9
EPA-82-E	7/7/94	22.6	3.7	106	357	2020	7.1	354.0	37.0	<0.05	NA	NA	NA	4.39	0.001	1.7
EPA-82-F	8/21/93	22.6	1.1	243	550	1275	7.5	68.5	63.9	<0.05	<0.05	NA	NA	7.41	0.019	2.2
EPA-82-F duplicate	8/21/93	NA	NA	NA	NA	NA	NA	71.8	67.9	NA	<0.05	NA	NA	7.46	NA	NA
EPA-82-F	11/9/93	16.8	1.1	NA	NA	NA	7.6	60.2	55.5	0.04	NA	NA	NA	5.07	0.006	1.9
EPA-82-F duplicate	11/93	NA	NA	NA	NA	NA	NA	60.7	55	NA	NA	NA	NA	5.06	NA	NA
EPA-82-F	7/7/94	21.5	<0.5	-70	490	1172	7.3	46.9	52.3	0.5	NA	NA	NA	1.67	0.577	4.4
EPA-82-H	8/22/93	18	6.3	190	485	1400	7.1	136	59.7	<0.05	<0.05	NA	NA	2.12	<0.001	2.2
EPA-82-H	11/8/93	15.7	5.4	NA	NA	NA	7.4	104	55.7	0.19	NA	NA	NA	2.01	<0.001	1.6
EPA-82-H	7/7/94	14.7	5.9	272	492	1384	7.2	129.0	62.3	<0.05	NA	NA	NA	1.51	0.001	2.6
EPA-82-I	11/93	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.68	NA
EPA-82-I	7/8/94	16.3	0.7	-90	491	1124	7.1	76.7	<0.5	10.3	NA	NA	NA	<0.05	1.886	67.1
EPA-82-J	7/12/94	14.7	2.2	NA	430	1280	7.0	158.0	<0.5	1.3	NA	NA	NA	0.05	0.052	46
MW-01	12/93-1/94	NA	0.3	NA	NA	NA	NA	NA	2	10.8	NA	<0.05	<0.01	<0.05	0.041	NA
MW-01 duplicate	12/93-1/94	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.042	NA
MW-02	12/93-1/94	NA	0.4	NA	NA	NA	NA	NA	40	50.5	NA	0.25	<0.01	0.25	<0.0003	NA
MW-03	12/93-1/94	NA	1.5	NA	NA	NA	NA	NA	<2	8.2	NA	<0.05	0.025	<0.05	0.459	NA
MW-04	12/93-1/94	NA	1.4	NA	NA	NA	NA	NA	<2	13.6	NA	1.68	0.637	2.32	0.012	NA
MW-05	12/93-1/94	NA	0.7	NA	NA	NA	NA	NA	<2	6.41	NA	<0.05	<0.01	<0.05	2.04	NA
MW-06	12/93-1/94	NA	0.8	NA	NA	NA	NA	NA	21	10.3	NA	0.04	0.031	0.07	0.002	NA
MW-07	12/93-1/94	NA	4.6	NA	NA	NA	NA	NA	26	1.36	NA	11.78	0.021	11.8	<0.001	NA
MW-08	12/93-1/94	NA	0.2	NA	NA	NA	NA	NA	11	5.22	NA	0.28	<0.01	0.28	0.006	NA
MW-09	12/93-1/94	NA	NA	NA	NA	NA	NA	NA	22	2.07	NA	0.4	0.577	0.4	0.006	NA
MW-10	8/18/93	15.4	0.6	125	518	1162	7.1	44.7	63.2	<0.05	<0.05	NA	NA	9.16	0.004	27.8
MW-10	11/9/93	15	1.5	NA	NA	NA	7.4	33.9	53.1	0.22	NA	NA	NA	17.4	0.001	5.3
MW-10 duplicate	11/9/93	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	17.1	NA	NA
MW-10	7/7/94	16.6	<0.5	-190	502	1076	7.3	47.1	19.5	0.8	NA	NA	NA	2.67	0.006	9.3

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TABLE 4.5 (Concluded)
GROUND WATER GEOCHEMICAL DATA
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

Sample Location	Sample Date	Water Temp. (°C)	Dissolved Oxygen (mg/L)	Redox Potential (mV)	Total Alkalinity (mg/L)	Conductivity (µS/cm)	pH	Chloride (mg/L)	Sulfate (mg/L)	Ferrous Iron (mg/L)	Ammonia (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	NO2+NO3 Nitrogen (mg/L)	Methane (mg/L)	TOC (mg/L)
MONITORING WELL SAMPLING LOCATIONS (Continued)																
MW-11	8/18/93	14.8	0.1	66	543	1209	7	48.7	97.6	0.2	0.25	NA	NA	0.36	0.117	8
MW-11 duplicate	8/18/93	NA	NA	NA	NA	NA	NA	NA	98	0.2	NA	NA	NA	NA	0.095	8
MW-11	11/9/93	14.7	0.1	NA	NA	NA	7.4	29.5	94.1	0.05	NA	NA	NA	0.17	0.022	4
MW-11 duplicate	11/9/93	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.8
MW-11	7/8/94	15.8	<0.5	140	504	1125	7.0	27.0	99.0	<0.05	NA	NA	NA	<0.05	0.005	3.5
MW-12	7/8/94	15.3	<0.5	171	450	959	7.1	13.2	29.2	<0.05	NA	NA	NA	7.73	0.005	2.4
MW-13	12/93-1/94	NA	NA	NA	NA	NA	NA	NA	3	10.3	NA	0.06	0.037	0.1	0.498	NA
MW-13 duplicate	12/93-1/94	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.483	NA
MW-14	12/93-1/94	NA	NA	NA	NA	NA	NA	NA	27.0	5.96	NA	1.72	0.187	1.91	0.023	NA
MW-14 duplicate	12/93-1/94	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.023	NA
GEOPROBE SAMPLING LOCATIONS																
71-17 CPT (depth 1)	8/3/93	24	5.8	135	384	1127	7.3	71.5	74.4	<0.05	0.3	NA	NA	3.78	0.0044	3.6
71-17 CPT (depth 1)	8/3/93	22.2	5.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
71-17 CPT (depth 2)	8/3/93	22	1.1	-10	451	1495	7.3	189	8.05	0.2	0.21	NA	NA	2.13	0.0064	2.1
71-18 CPT (depth 1)	8/3/93	NA	NA	NA	NA	NA	NA	109	34.8	0.2	0.26	NA	NA	1.85	0.0007	NA
71-18 CPT (depth 1)	8/3/93	NA	NA	NA	NA	NA	NA	108	34.6	NA	0.17	NA	NA	1.91	NA	NA
71-18 CPT (depth 2)	8/3/93	20	1.1	180	440	1151	7.4	90.2	39.4	<0.05	0.11	NA	NA	3.89	0.0017	1.6
71-18 CPT (depth 2)	8/3/93	NA	NA	NA	NA	NA	NA	90.3	39.8	0.6	NA	NA	NA	NA	NA	NA
71-19 CPT (depth 1)	8/2/93	25	0.5	-63	612	1196	7.1	50.5	5.68	0.6	0.99	NA	NA	0.19	0.0564	5.4
71-19 CPT (depth 1)	8/2/93	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.0552	NA
71-23 CPT (depth 1)	8/5/93	19	NA	274	632	1451	7.4	118	51.2	0.1	0.14	NA	NA	2.7	0.0001	2.1
71-23 CPT (depth 2)	8/5/93	18.7	4.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
71-29 CPT (depth 1)	8/2/93	25	2	99	457	1604	7.1	NA	NA	<0.05	0.3	NA	NA	1.4	0.0007	2.7
71-29 CPT (depth 2)	8/2/93	22.5	NA	-137	452	1256	7.4	107	52.6	<0.05	<0.05	NA	NA	3.9	0.0541	1.9
71-29 CPT (depth 2)	8/2/93	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2
71-29 CPT (depth 7)	8/2/93	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.19	NA	NA	1.59	NA	NA
71-31 CPT (depth 1)	8/3/93	25	NA	162	394	1099	7.3	93.2	46.9	0.1	<0.05	NA	NA	3.66	0.0032	2.7
71-31 CPT (depth 1)	8/3/93	NA	4.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
71-31 CPT (depth 2)	8/3/93	23	4.2	152	378	1082	7.3	91.7	47.4	<0.05	<0.05	NA	NA	4.69	0.0111	1.9
71-38 CPT (depth 1)	8/3/93	NA	NA	NA	NA	NA	NA	170	58	NA	<0.05	NA	NA	3.77	0.035	3.3
71-38 CPT (depth 1)	8/3/93	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.3
71-38 CPT (depth 2)	8/3/93	18	1.8	56	646	1628	7.3	NA	NA	<0.05	NA	NA	NA	NA	NA	NA
71-39 CPT (depth 1)	8/5/93	21	NA	179	592	1525	7.7	161	56.8	0.05	<0.05	NA	NA	4.17	0.0141	2.8
71-39 CPT (depth 1)	8/5/93	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.0219	2.9
71-39 CPT (depth 2)	8/5/93	24	NA	207	451	1321	8.3	114	31.5	<0.05	<0.05	NA	NA	4.13	NA	NA
71-39 CPT (depth 2)	8/5/93	NA	NA	NA	NA	NA	NA	116	NA	NA	NA	NA	NA	NA	NA	NA
71-8 CPT (depth 1)	8/93	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.0212	8
EPA-82-L1	7/9/94	17.2	<0.5	-106	730	1662	7.1	112.0	<0.5	2.4	NA	NA	NA	<0.05	0.018	5.6
EPA-82-L1 duplicat	7/9/94	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.05	NA	4.4
EPA-82-L2	7/9/94	17.6	<0.5	-30	732	1584	7.1	86.4	36.0	0.1	NA	NA	NA	0.05	0.003	3.1
EPA-82-L3	7/9/94	18.6	<0.5	-10	706	1530	7.3	90.1	61.0	0.1	NA	NA	NA	0.3	0.002	2.4
EPA-82-M	7/9/94	18.8	1.2	208	666	1450	7.3	73.8	35.4	<0.05	NA	NA	NA	1.8	0.121	2.9
EPA-82-N	7/11/94	20.6	2.0	250	256	1278	7.4	120.0	42.6	<0.05	NA	NA	NA	1.14	0.004	3.7
EPA-82-O	7/11/94	17.7	0.5	120	566	1403	7.4	78.4	37.1	<0.05	NA	NA	NA	1.63	0.001	2.8
EPA-82-K	7/11/94	20.9	2.0	197	498	1171	7.8	60.0	59.8	<0.05	NA	NA	NA	4.44	0.003	2.4
EPA-82-P	7/11/94	NA	<0.5	NA	792	1671	7.4	148.0	<0.5	0.2	NA	NA	NA	<0.05	0.004	6.8

See Appendix C for analytical methods
EST=Estimated value reported by lab

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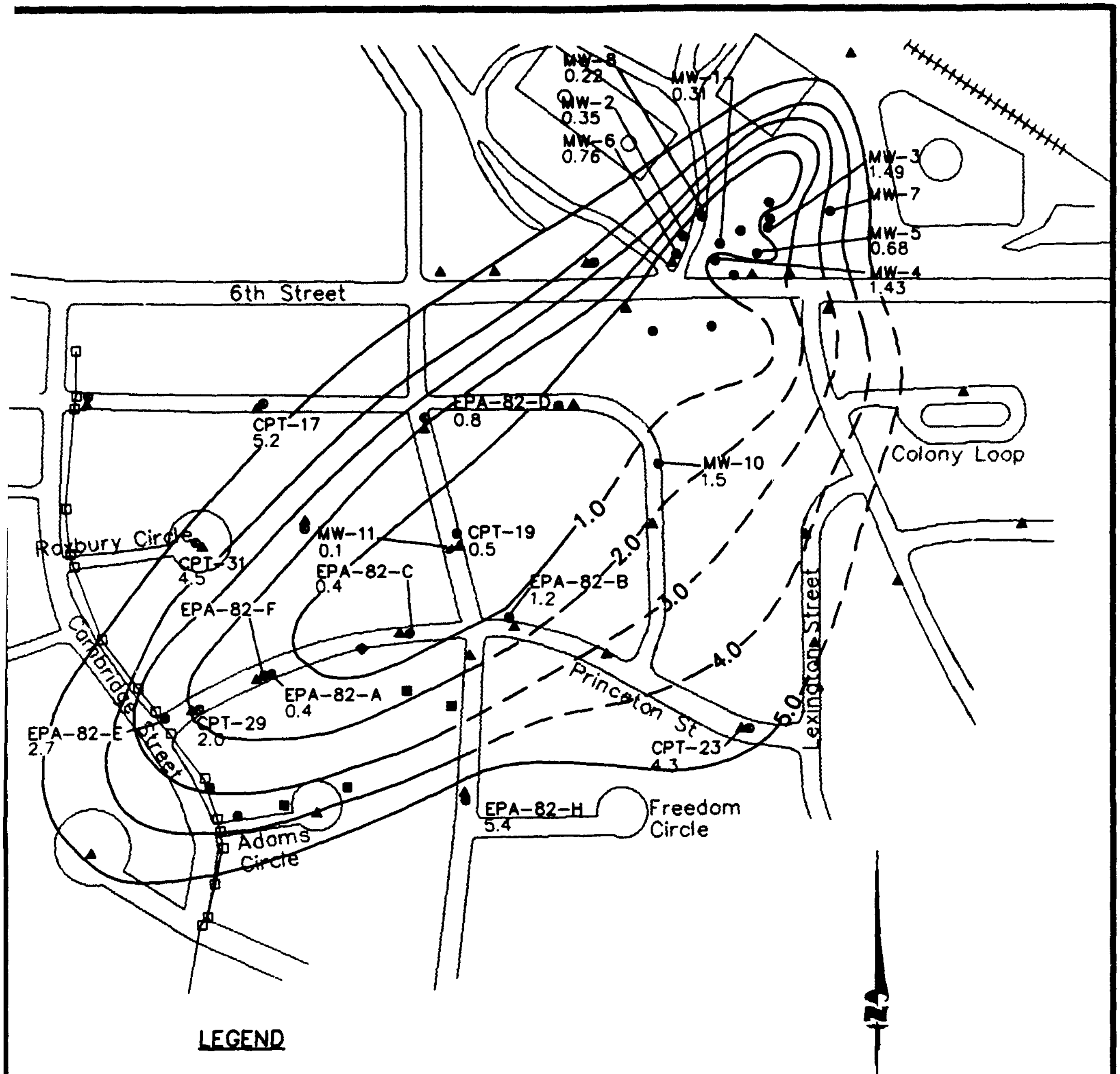

LEGEND

CPT-26 ▲	CONE PENETROMETER TEST POINT/ PIEZOMETER
MW-11 ●	MONITORING WELL LOCATION
●	AUGUST 1993 GEOPROBE SAMPLING LOCATION
□	STORM DRAIN SURVEY LOCATION
EPA-82-M ■	JULY 1994 GEOPROBE SAMPLING LOCATION
EPA-82-KK ◆	JULY 1994 SOIL BORING LOCATION
—2.0—	LINE OF EQUAL DISSOLVED OXYGEN CONCENTRATION (mg/L)(AUGUST 1993) (DASHED WHERE INFERRED)

CONTOUR INTERVAL = 1.0 mg/L

FIGURE 4.6

DISSOLVED OXYGEN ISOPLETH FOR GROUNDWATER AUGUST 1993

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of Figures 4.4 and 4.6 and Figures 4.5 and 4.7 shows graphically that areas with elevated total BTEX concentrations have depleted DO concentrations. This is a strong indication that aerobic biodegradation of the BTEX compounds is occurring at the site.

In the absence of microbial cell production, the oxidation (biodegradation) of benzene to carbon dioxide and water is given by:

$$C_6H_6 + 7.5O_2 \rightarrow 6CO_2 + 3H_2O$$

Therefore, 7.5 moles of oxygen are required to mineralize 1 mole of benzene. On a mass basis, the ratio of oxygen to benzene is given by:

Molecular weights:	Benzene	6(12) + 6(1) = 78 gm/mole
	Oxygen	7.5(32) = 240 gm/mole

Mass Ratio of Oxygen to Benzene = 240/78 = 3.08:1

In the absence of microbial cell production, 3.08 mg of oxygen are required to completely mineralize 1 mg of benzene. Similar calculations can be completed for toluene (3.13 mg oxygen to 1 mg toluene), ethylbenzene (3.17 mg oxygen to 1 mg ethylbenzene), and the xylenes (3.17 mg oxygen to 1 mg xylene). The average mass ratio of oxygen consumed to total BTEX degraded is thus 3.14:1. This means that approximately 0.32 mg of BTEX is mineralized to carbon dioxide and water for every 1.0 mg of DO consumed. With a background DO concentration of approximately 6 mg/L, the shallow ground water at this site has the capacity to assimilate 1.9 mg/L (1,900 µg/L) of total BTEX. This is a very conservative estimate of the assimilative capacity of DO because microbial cell mass production was not taken into account by the stoichiometry shown above.

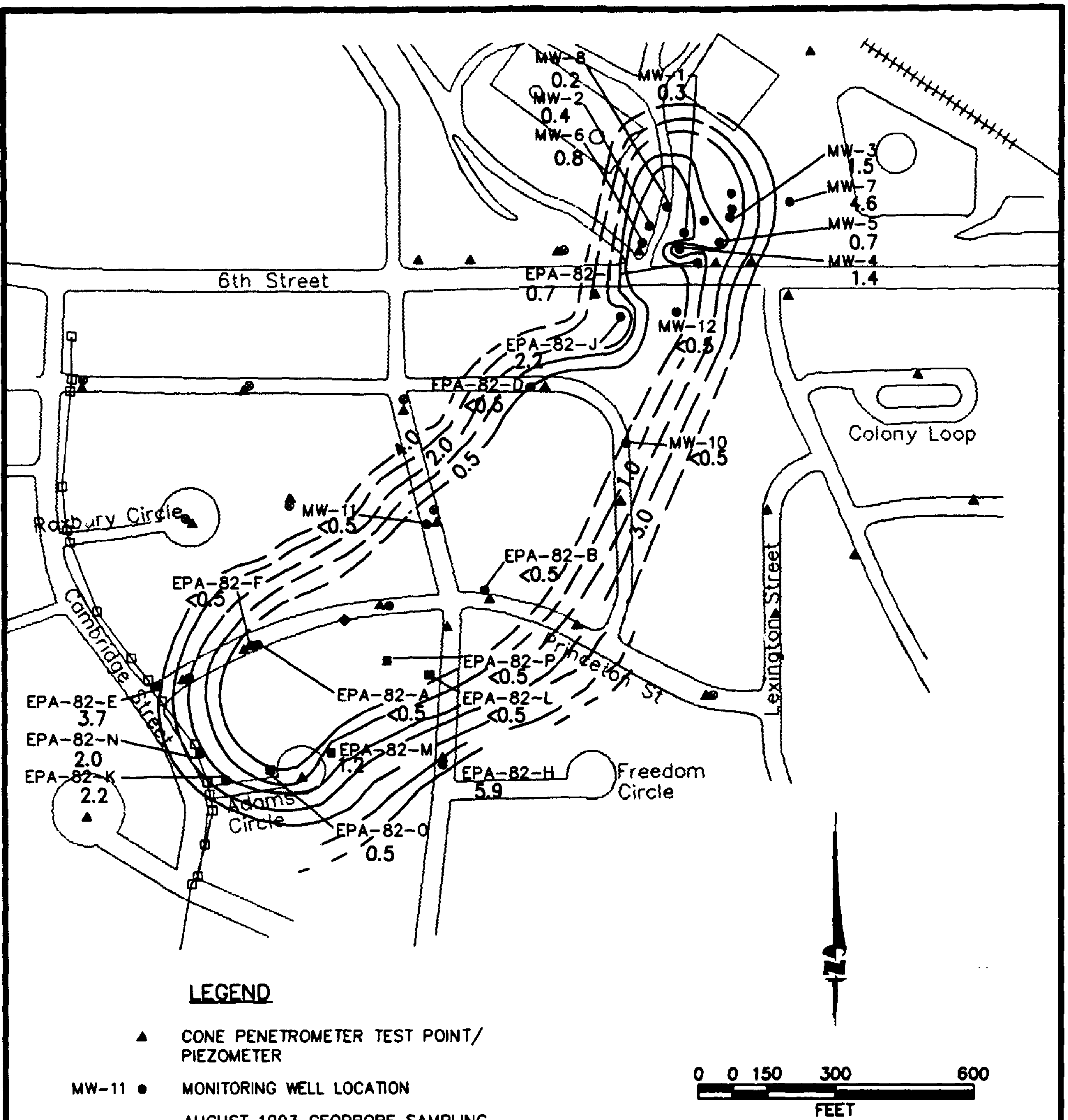
When cell mass production is accounted for, the mineralization of benzene to carbon dioxide and water is given by:

$$C_6H_6 + 2.5O_2 + HCO_3 + NH_4 \rightarrow C_5H_7O_2N + 2CO_2 + 2H_2O$$

From this it can be seen that only 2.5 moles of DO are required to mineralize 1 mole of benzene when cell mass production is taken into account. On a mass basis, the ratio of DO to benzene is given by:

Molecular weights:	Benzene	12(6) + 1(6) = 78 gm/mole
	Oxygen	2.5(32)= 80 gm/mole

Mass Ratio of Oxygen to Benzene = 80/78 = 1.03:1



LEGEND

- ▲ CONE PENETROMETER TEST POINT/ PIEZOMETER
- MW-11 ● MONITORING WELL LOCATION
- ⊗ AUGUST 1993 GEOPROBE SAMPLING LOCATION
- □ STORM DRAIN SURVEY LOCATION
- ■ JULY 1994 GEOPROBE SAMPLING LOCATION
- ◆ JULY 1994 SOIL BORING LOCATION
- —1.0— LINE OF EQUAL DISSOLVED OXYGEN CONCENTRATION (mg/L) (DASHED WHERE INFERRED)

CONTOUR INTERVAL = VARIABLE

FIGURE 4.7

DISSOLVED OXYGEN ISOPLETH FOR GROUNDWATER JULY 1994

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Based on these stoichiometric relationships, 1.03 mg of oxygen are required to mineralize 1 mg of benzene. Similar calculations can be made for toluene, ethylbenzene, and the xylenes. Based on this, approximately 0.97 mg of BTEX is mineralized to carbon dioxide and water for every 1.0 mg of DO consumed. With a background DO concentration of approximately 6 mg/L, the shallow ground water at this site has the capacity to assimilate 5.8 mg/L (5,800 μg/L) of total BTEX if microbial cell mass production is taken into account.

4.3.2.2 Nitrate/Nitrite

Concentrations of nitrate + nitrite (as N) were measured at Geoprobe® locations and monitoring points/wells in August 1993, November 1993, December 1993/January 1994, and July 1994. In addition, ground water samples were collected and analyzed for ionic nitrate and nitrite in December 1993/January 1994. Table 4.5 summarizes measured nitrate and nitrite concentrations. Figure 4.8 is an isopleth map showing the distribution of nitrate + nitrite (as N) in ground water in August 1993. Figure 4.9 is an isopleth map showing the distribution of nitrate + nitrite (as N) in ground water in July 1994. These figures include data collected from monitoring wells in the source area north of Sixth Street in December 1993/January 1994. These wells cover a small area and these data represent the only data available for this area. Comparison of Figures 4.4 and 4.8 and Figures 4.5 and 4.9, shows graphically that areas with elevated total BTEX concentrations have depleted nitrate + nitrite concentrations. Comparison of Figures 4.6 and 4.8 and Figures 4.7 and 4.9, shows graphically that areas with depleted DO concentrations have depleted nitrate + nitrite concentrations. These relationships provide strong evidence that anaerobic biodegradation of the BTEX compounds is occurring at the site through the microbially mediated process of denitrification.

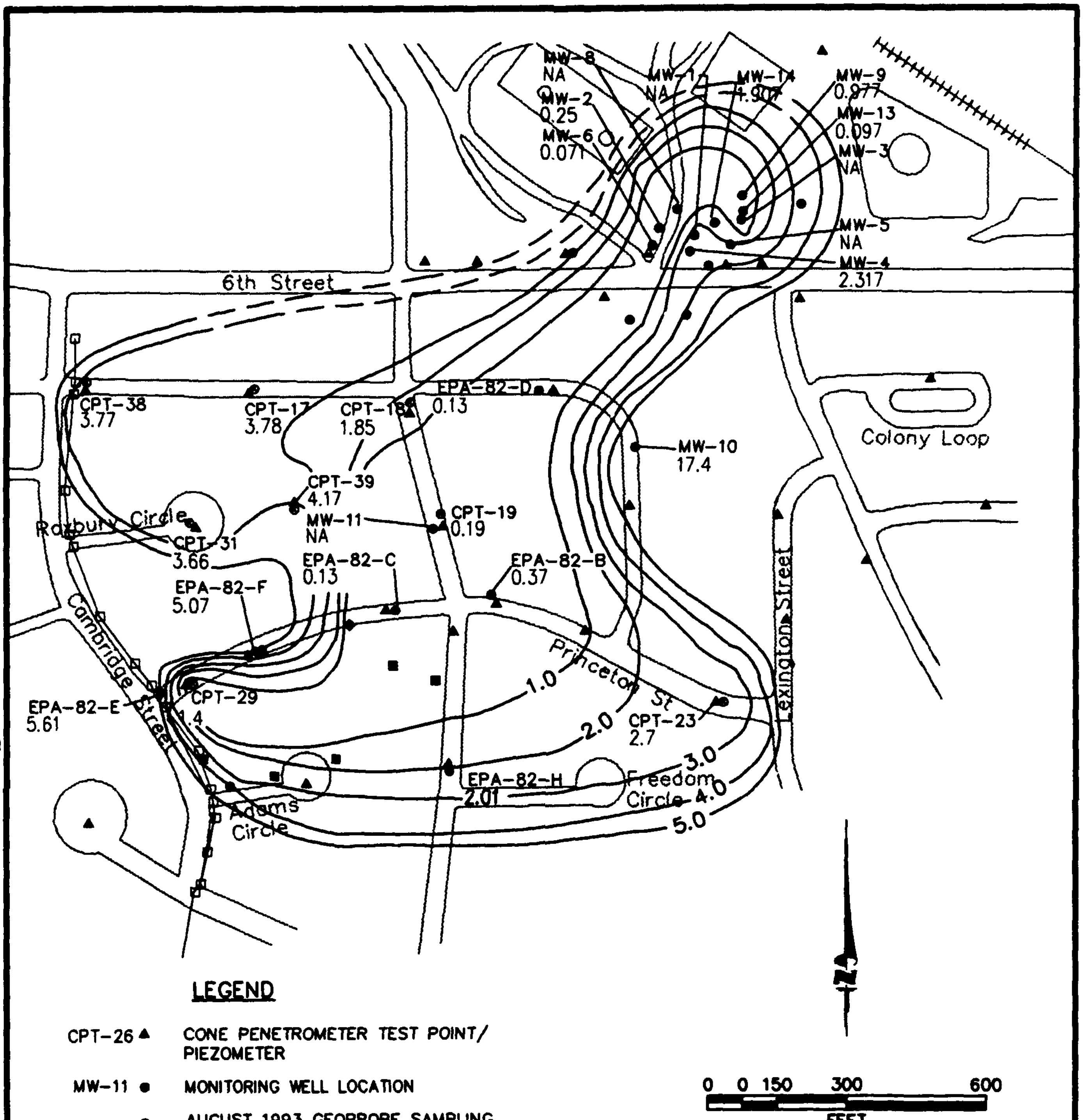
In the absence of microbial cell production, the biodegradation of benzene to carbon dioxide and water is given by:

$$6NO_3^- + 6H^+ + C_6H_6 \rightarrow 6CO_{2(g)} + 6H_2O + 3N_{2(g)}$$

Based on this relationship, 6 moles of nitrate are required to mineralize 1 mole of benzene. On a mass basis, the ratio of nitrate to benzene is given by:

Molecular weights:	Benzene	6(12) + 6(1) = 78 gm/mole
	Nitrate	6(62) = 372 gm/mole

Mass ratio of nitrate to benzene = 372/78 = 4.77:1



LEGEND

CPT-26 ▲	CONE PENETROMETER TEST POINT/ PIEZOMETER
MW-11 ●	MONITORING WELL LOCATION
●	AUGUST 1993 GEOPROBE SAMPLING LOCATION
◻	STORM DRAIN SURVEY LOCATION
EPA-82-M ■	JULY 1994 GEOPROBE SAMPLING LOCATION
EPA-82-KK ◆	JULY 1994 SOIL BORING LOCATION
— 3 —	LINE OF EQUAL NITRATE AND NITRITE CONCENTRATION (mg/L) (AUGUST 1993, DECEMBER 1993 THROUGH JANUARY 1994) (DASHED WHERE INFERRED)

CONTOUR INTERVAL = 1 mg/L

FIGURE 4.8

NITRATE + NITRITE ISOPLETH FOR GROUNDWATER AUGUST 1993

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Denver, Colorado

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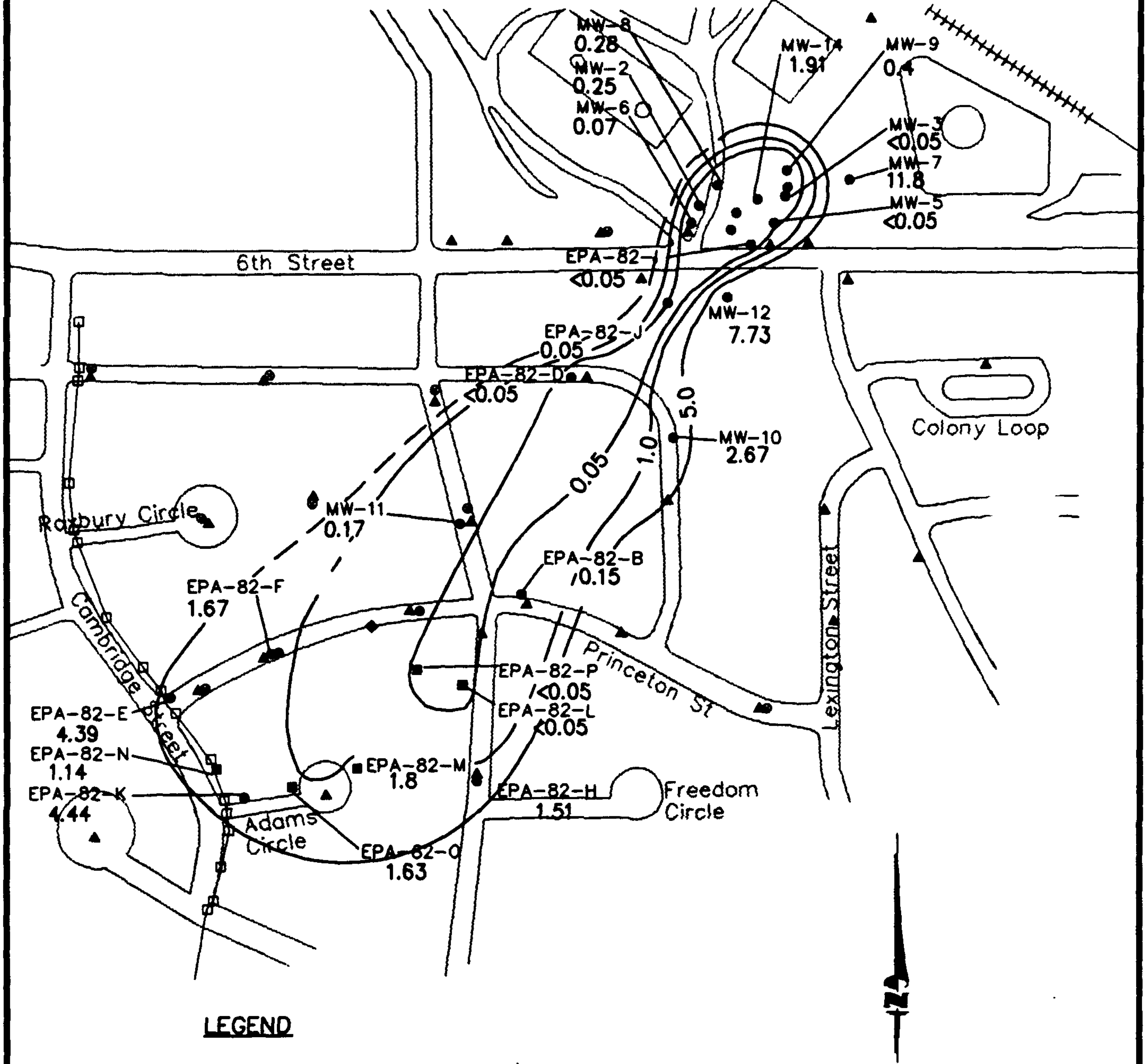

LEGEND

- ▲ CONE PENETROMETER TEST POINT/ PIEZOMETER
- MW-11 ● MONITORING WELL LOCATION
- ● AUGUST 1993 GEOPROBE SAMPLING LOCATION
- □ STORM DRAIN SURVEY LOCATION
- ■ JULY 1994 GEOPROBE SAMPLING LOCATION
- ◆ JULY 1994 SOIL BORING LOCATION
- —1.0— LINE OF EQUAL NITRATE + NITRITE CONCENTRATION (mg/L) (DASHED WHERE INFERRED)

CONTOUR INTERVAL = VARIABLE

FIGURE 4.9

NITRATE + NITRITE ISOPLETH FOR GROUNDWATER JULY 1994

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Intrinsic Remediation EE/CA
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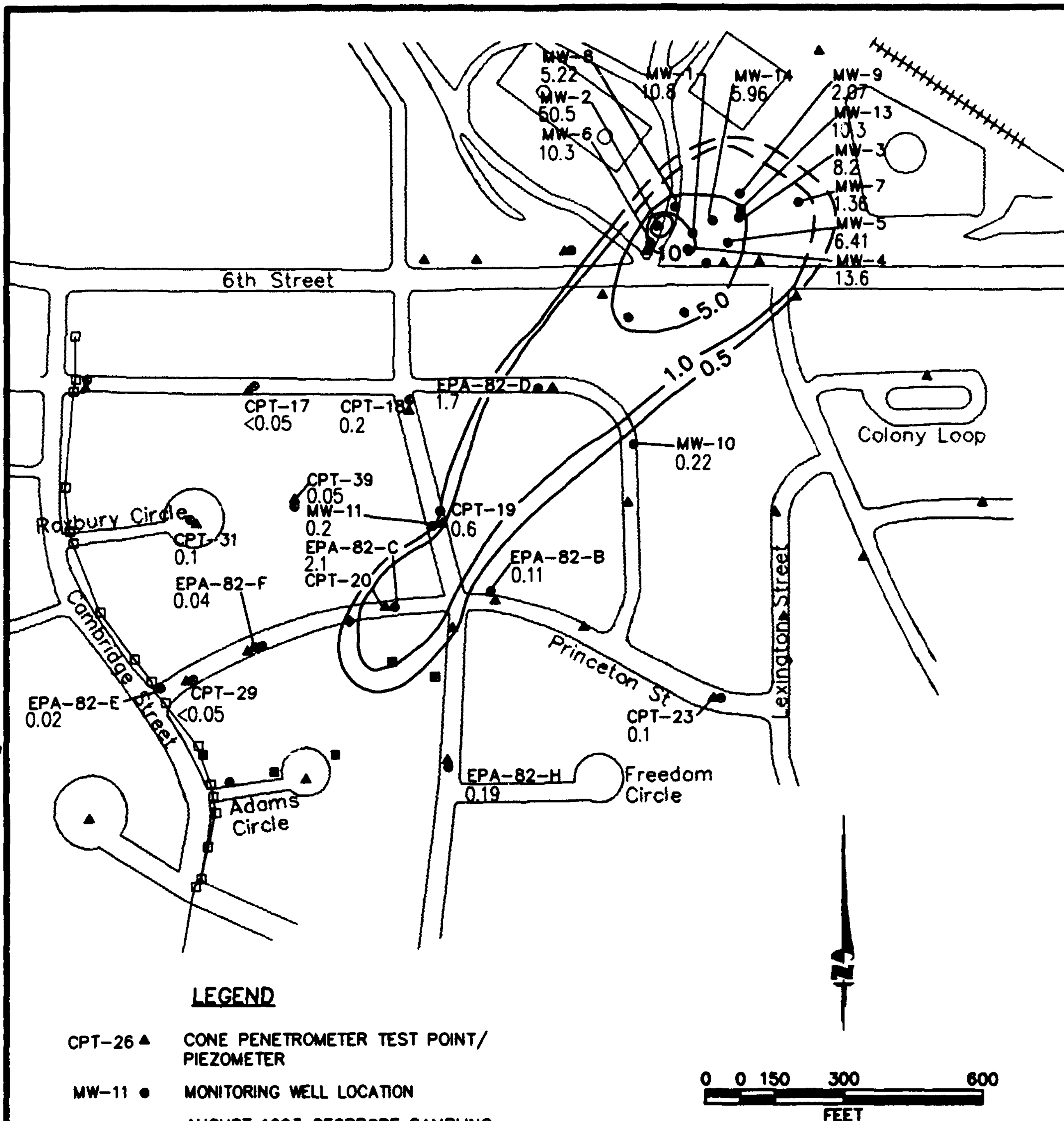
In the absence of microbial cell production, 4.77 mg of nitrate are required to completely mineralize 1 mg of benzene. Similar calculations can be completed for toluene (4.85 mg nitrate to 1 mg toluene), ethylbenzene (4.92 mg nitrate to 1 mg ethylbenzene), and the xylenes (4.92 mg nitrate to 1 mg xylene). The average mass ratio of nitrate consumed to total BTEX degraded is 4.9:1. This means that approximately 0.21 mg of BTEX is mineralized for every 1.0 mg of nitrate consumed. With a background nitrate concentration of approximately 17 mg/L, the shallow ground water at this site has the capacity to assimilate 3.57 mg/L (3,570 µg/L) of total BTEX during denitrification. This is a very conservative estimate of the assimilative capacity of nitrate because microbial cell mass production has not been taken into account by the stoichiometry shown above (see Section 4.3.2.1).

4.3.2.3 Ferrous Iron

Ferrous iron concentrations were measured at Geoprobe® locations and monitoring points/wells in August 1993, November 1993, December 1993/January 1994, and July 1994. Table 4.5 summarizes ferrous iron concentrations. Figure 4.10 is an isopleth map showing the distribution of ferrous iron in ground water in August 1993. Figure 4.11 is an isopleth map showing the distribution of ferrous iron in ground water in July 1994. These figures include data collected from monitoring wells in the source area north of Sixth Street in December 1993/January 1994. These wells cover a small area and these data represent the only data available for this area. Comparison of Figures 4.4 and 4.10 and Figures 4.5 and 4.11 shows graphically that areas with elevated total BTEX concentrations have elevated ferrous iron concentrations. This is an indication that ferric iron is potentially being reduced to ferrous iron during biodegradation of BTEX compounds. However, it is possible that sulfate reduction at the site is reducing the redox potential of the ground water to sufficiently low levels to cause the dissolution of iron-bearing minerals in the shallow saturated soils at the site, thus elevating ferrous iron concentrations through non-biological processes. The highest measured ferrous iron concentration was 50.5 mg/L at monitoring well MW-02. Background levels of ferrous iron are at or below 0.05 mg/L, as measured at wells located outside of known BTEX contamination depicted on Figures 4.4 and 4.5.

The following equations describe the overall stoichiometry of benzene biodegradation by iron reduction through microbial biodegradation. In the absence of microbial cell production, the biodegradation of benzene is given by:

$$60H^+ + 30Fe(OH)_{3,a} + C_6H_6 \rightarrow 6CO_2 + 30Fe^{2+} + 78H_2O$$



LEGEND

CPT-26 ▲	CONE PENETROMETER TEST POINT/ PIEZOMETER
MW-11 ●	MONITORING WELL LOCATION
●	AUGUST 1993 GEOPROBE SAMPLING LOCATION
□	STORM DRAIN SURVEY LOCATION
EPA-82-M ■	JULY 1994 GEOPROBE SAMPLING LOCATION
EPA-82-KK ◆	JULY 1994 SOIL BORING LOCATION
—0.20—	LINE OF EQUAL IRON CONCENTRATION (mg/L) (AUGUST 1993, DECEMBER 1993 THROUGH JANUARY 1994) (DASHED WHERE INFERRED)
	CONTOUR INTERVAL = VARIABLE

FIGURE 4.10

FERROUS IRON ISOPLETH FOR GROUNDWATER AUGUST 1993

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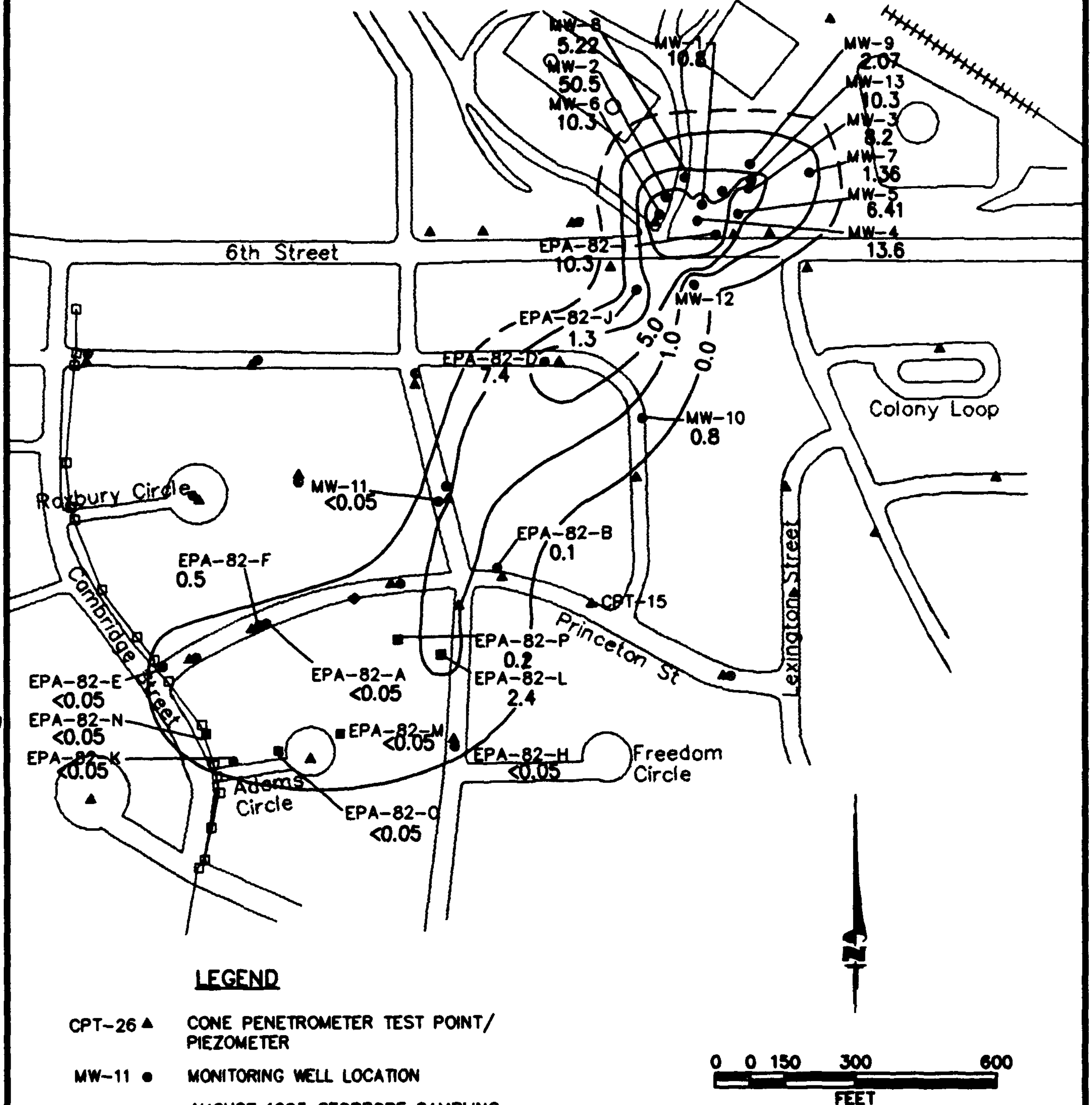

LEGEND

CPT-26 ▲ CONE PENETROMETER TEST POINT/ PIEZOMETER

MW-11 ● MONITORING WELL LOCATION

● AUGUST 1993 GEOPROBE SAMPLING LOCATION

□ STORM DRAIN SURVEY LOCATION

EPA-82-M ■ JULY 1994 GEOPROBE SAMPLING LOCATION

EPA-82-KK ◆ JULY 1994 SOIL BORING LOCATION

—1.0— LINE OF EQUAL FERROUS IRON CONCENTRATION (mg/L) (DASHED WHERE INFERRED)

CONTOUR INTERVAL = VARIABLE

FIGURE 4.11

FERROUS IRON ISOPLETH FOR GROUNDWATER JULY 1994

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Therefore, 30 moles of $Fe(OH)_3$ are required to mineralize 1 mole of benzene. On a mass basis, the ratio of $Fe(OH)_3$ to benzene is given by:

Molecular weights:	Benzene	6(12) + 6(1) = 78 gm/mole
	$Fe(OH)_3$	30(106.85) = 3205 gm/mole

Mass ratio of $Fe(OH)_3$ to benzene = 3205.41/78 = 41.1:1

Therefore, in the absence of microbial cell production, 41.1 mg of $Fe(OH)_3$ are required to completely mineralize 1 mg of benzene. Alternatively, the mass ratio of ferrous iron produced during respiration to benzene degraded can be calculated and is given by:

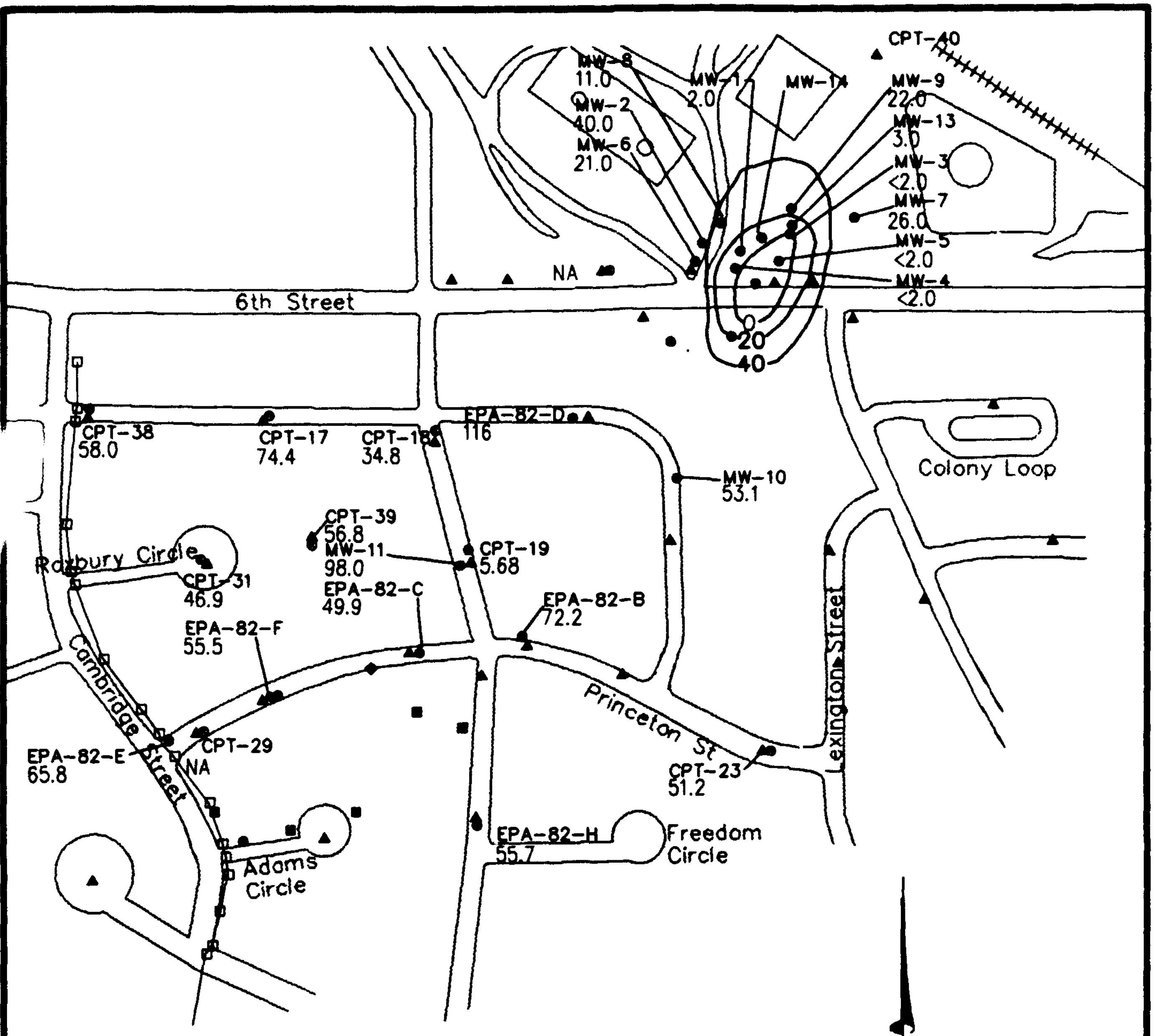
Molecular weights:	Benzene	6(12) + 6(1) = 78 gm/mole
	Fe^{2+}	30(55.85) = 1675.5 gm/mole

Mass ratio of Fe^{2+} to benzene = 1675.5/78 = 21.5:1

Therefore, 21.5 mg of Fe^{2+} are produced during biodegradation of 1 mg of benzene. Similar calculations can be completed for toluene (21.86 mg of Fe^{2+} produced during biodegradation of 1 mg of toluene), ethylbenzene (22.0 mg of Fe^{2+} produced during biodegradation of 1 mg of ethylbenzene), and the xylenes (22.0 mg of Fe^{2+} produced during biodegradation of 1 mg of xylene). The average mass ratio of Fe^{2+} produced during total BTEX biodegradation is thus 21.8:1. This means that approximately 1 mg of BTEX is mineralized for every 21.8 mg of Fe^{2+} produced. The highest measured Fe^{2+} concentration was 50.5 mg/L. This suggests that the shallow ground water at this site has the capacity to assimilate 2.3 mg/L (2,300 µg/L) of total BTEX during iron reduction. Again, this is a very conservative estimate of the assimilative capacity of iron because microbial cell mass production has not been taken into account by the stoichiometry shown above (see Section 4.3.2.1). In addition, this calculation is based on observed ferrous iron concentrations and not on the amount of ferric hydroxide available in the aquifer. Therefore, iron assimilative capacity could be much higher.

4.3.2.4 Sulfate

Sulfate concentrations were measured at Geoprobe® locations and monitoring points/wells in August 1993, November 1993, December 1993/January 1994, and July 1994. Table 4.5 summarizes measured sulfate concentrations. Figure 4.12 is a map showing sulfate concentrations in ground water in August 1993. There does not appear to be any clear trend between BTEX and sulfate concentrations downgradient of the source (compare Figure 4.12 to Figure 4.5) and near the leading edge of BTEX contamination in August 1993. However,



LEGEND

CPT-26 ▲	CONE PENETROMETER TEST POINT/ PIEZOMETER
MW-11 ●	MONITORING WELL LOCATION
●	AUGUST 1993 GEOPROBE SAMPLING LOCATION
□	STORM DRAIN SURVEY LOCATION
EPA-82-M ■	JULY 1994 GEOPROBE SAMPLING LOCATION
EPA-82-KK ◆	JULY 1994 SOIL BORING LOCATION
—100—	LINE OF EQUAL SULFATE CONCENTRATION (mg/L)
	CONTOUR INTERVAL = 20 mg/L

0 0 150 300 600
FEET

FIGURE 4.12

SULFATE ISOPLETH IN GROUNDWATER AUGUST 1993

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localized sulfate reductions are seen in the source area. Figure 4.13 is an isopleth map showing the distribution of sulfate in ground water in July 1994. This figure includes data collected from monitoring wells in the source area north of Sixth Street in December 1993/January 1994. These wells cover a small area and these data represent the only data available for this area. Comparison of Figures 4.5 and 4.13, shows graphically that by July 1994, areas with elevated total BTEX concentrations had depleted sulfate concentrations. This is a strong indication that the rate of anaerobic biodegradation of the BTEX compounds through sulfanogenesis increased from 1993 to 1994. It is possible that the redox reactions required for sulfate reduction to proceed in the ground water environment in 1993 were not microbially mediated, and that the depletion of other available electron acceptors by 1994 likely increased the importance of sulfate reducing processes.

The following equations describe the overall stoichiometry of BTEX oxidation by sulfate reduction caused by anaerobic microbial biodegradation. In the absence of microbial cell production, the biodegradation of benzene is given by:

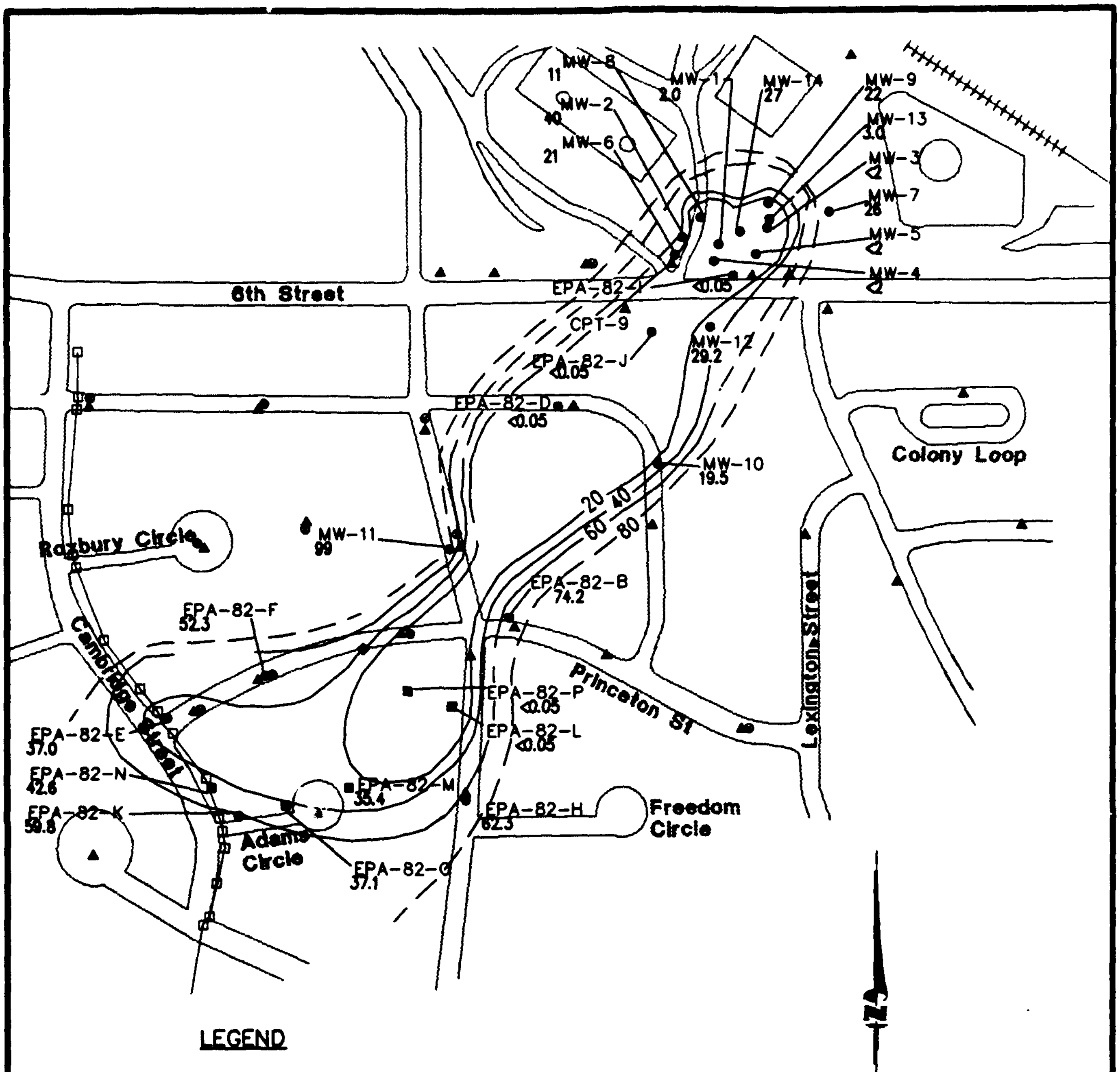
$$7.5H^{+} + 3.75SO_4^{2-} + C_6H_6 \rightarrow 6CO_{2(g)} + 3.75H_2S^{o} + 3H_2O$$

Therefore, 3.75 moles of sulfate are required to mineralize 1 mole of benzene. On a mass basis, the ratio of sulfate to benzene is given by:

Molecular weights:	Benzene	6(12) + 6(1) = 78 gm/mole
	Sulfate	3.75(96) = 360 gm/mole

Mass ratio of sulfate to benzene = 360/78 = 4.6:1

Therefore, in the absence of microbial cell production, 4.6 mg of sulfate are required to completely mineralize 1 mg of benzene. Similar calculations can be completed for toluene (4.7 mg sulfate to 1 mg toluene), ethylbenzene (4.75 mg sulfate to 1 mg ethylbenzene), and the xylenes (4.75 mg sulfate to 1 mg xylene). The average mass ratio of sulfate to total BTEX is thus 4.7:1. This means that approximately 0.21 mg of BTEX is mineralized for every 1.0 mg of sulfate consumed. Assuming a background sulfate concentration of 100 mg/L, the shallow ground water at this site has the capacity to assimilate 21 mg/L (21,000 µg/L) of total BTEX during sulfanogenesis. Again, this is a very conservative estimate of the assimilative capacity of sulfate because microbial cell mass production has not been taken into account by the stoichiometry shown above (see Section 4.3.2.1).



LEGEND

CPT-26 ▲	CONE PENETROMETER TEST POINT/ PIEZOMETER
MW-11 ●	MONITORING WELL LOCATION
●	AUGUST 1993 GEOPROBE SAMPLING LOCATION
□	STORM DRAIN SURVEY LOCATION
EPA-82-M ■	JULY 1994 GEOPROBE SAMPLING LOCATION
EPA-82-KK ◆ 11.0	JULY 1994 SOIL BORING LOCATION SULFATE CONCENTRATION (mg/L)
—20.0—	LINE OF EQUAL SULFATE CONCENTRATION (mg/L) (DASHED WHERE INFERRED)

CONTOUR INTERVAL = 20 mg/L

0 0 150 300 600

FEET

FIGURE 4.13

SULFATE ISOPLETH FOR GROUND WATER JULY 1994

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4.3.1.5 Methane

Methane concentrations were measured at Geoprobe® locations and monitoring points/wells in August 1993, November 1993, and December 1993/January 1994. Table 4.5 summarizes methane concentrations. Background levels of methane appear to be below 0.001 mg/L at wells located outside areas with known BTEX contamination. The highest methane concentration observed at the site was 2.04 mg/L in MW-5. Figure 4.14 is an isopleth map showing the distribution of methane in ground water in August 1993. Figure 4.15 is an isopleth map showing the distribution of methane in ground water in July 1994. These figures include data collected from monitoring wells in the source area north of Sixth Street in December 1993/January 1994. These wells cover a small area and these data represent the only data available for this area. Comparison of Figures 4.4 and 4.14 and Figures 4.5 and 4.15, shows graphically that areas with elevated total BTEX concentrations have elevated methane concentrations. This is a strong indication that anaerobic biodegradation of the BTEX compounds is occurring at the site through the microbially mediated process of methanogenesis.

Comparison of Figures 4.14 and 4.15 suggests that methanogenesis, like sulfanogenesis, may have become a more important BTEX-degradation mechanism between August 1993 and July 1994. This is consistent with other electron acceptor data found at the site with the area having elevated methane concentrations being confined to areas with depleted DO, nitrate, and sulfate concentrations and elevated ferrous iron concentrations (compare Figures 4.6 through 4.15). In addition, comparison of Figures 4.14 and 4.15 suggests that methanogenesis is becoming a more important BTEX degradation mechanism as the BTEX plume matures.

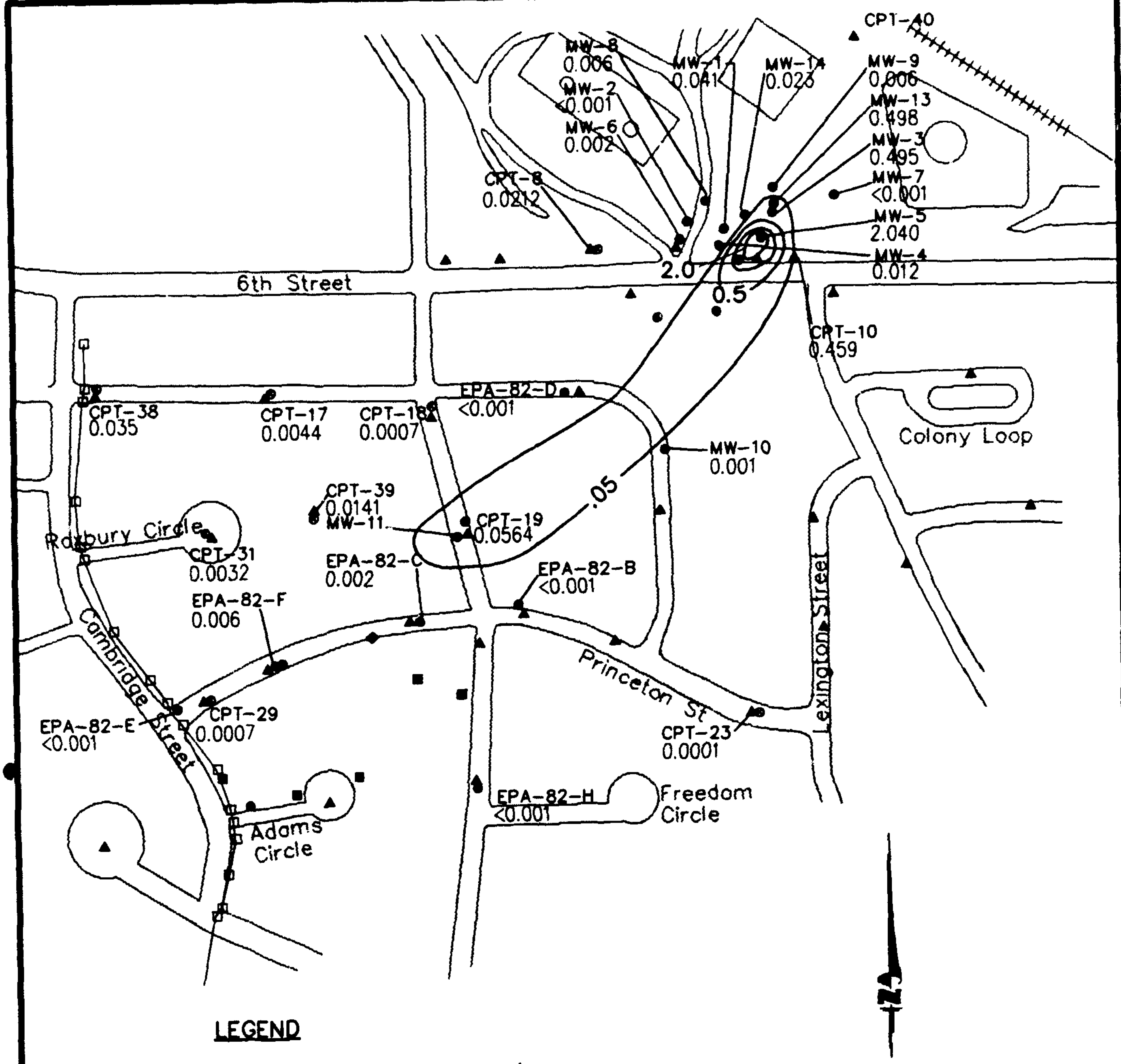
The following equations describe the overall stoichiometry of benzene biodegradation by methanogenesis. In the absence of microbial cell production, the biodegradation of benzene is given by:

$$C_6H_6 + 4.5H_2O \rightarrow 2.25CO_2 + 3.75CH_4$$

The mass ratio of methane produced during respiration to benzene degraded can be calculated and is given by:

Molecular weights:	Benzene	$6(12) + 6(1) = 78$ gm/mole
	Methane	$3.75(16) = 60$ gm/mole

Mass ratio of methane to benzene = 60/78 = 0.77:1



LEGEND

CPT-26 ▲ CONE PENETROMETER TEST POINT/ PIEZOMETER

MW-11 ● MONITORING WELL LOCATION

● AUGUST 1993 GEOPROBE SAMPLING LOCATION

□ STORM DRAIN SURVEY LOCATION

EPA-82-M ■ JULY 1994 GEOPROBE SAMPLING LOCATION

EPA-82-KK ◆ JULY 1994 SOIL BORING LOCATION

— 0.01 — LINE OF EQUAL METHANE CONCENTRATION (mg/L) (AUGUST 1993, DECEMBER 1993 THROUGH JANUARY 1994)

CONTOUR INTERVAL = VARIABLE

FIGURE 4.14

METHANE ISOPLETH FOR GROUNDWATER AUGUST 1993

UST Site 870
Intrinsic Remediation EE/CA
Hill Air Force Base, Utah

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

L:\45002\DRAWINGS\95DN0438, 3/17/95 at 13:30 LAYER: METHANE_1993

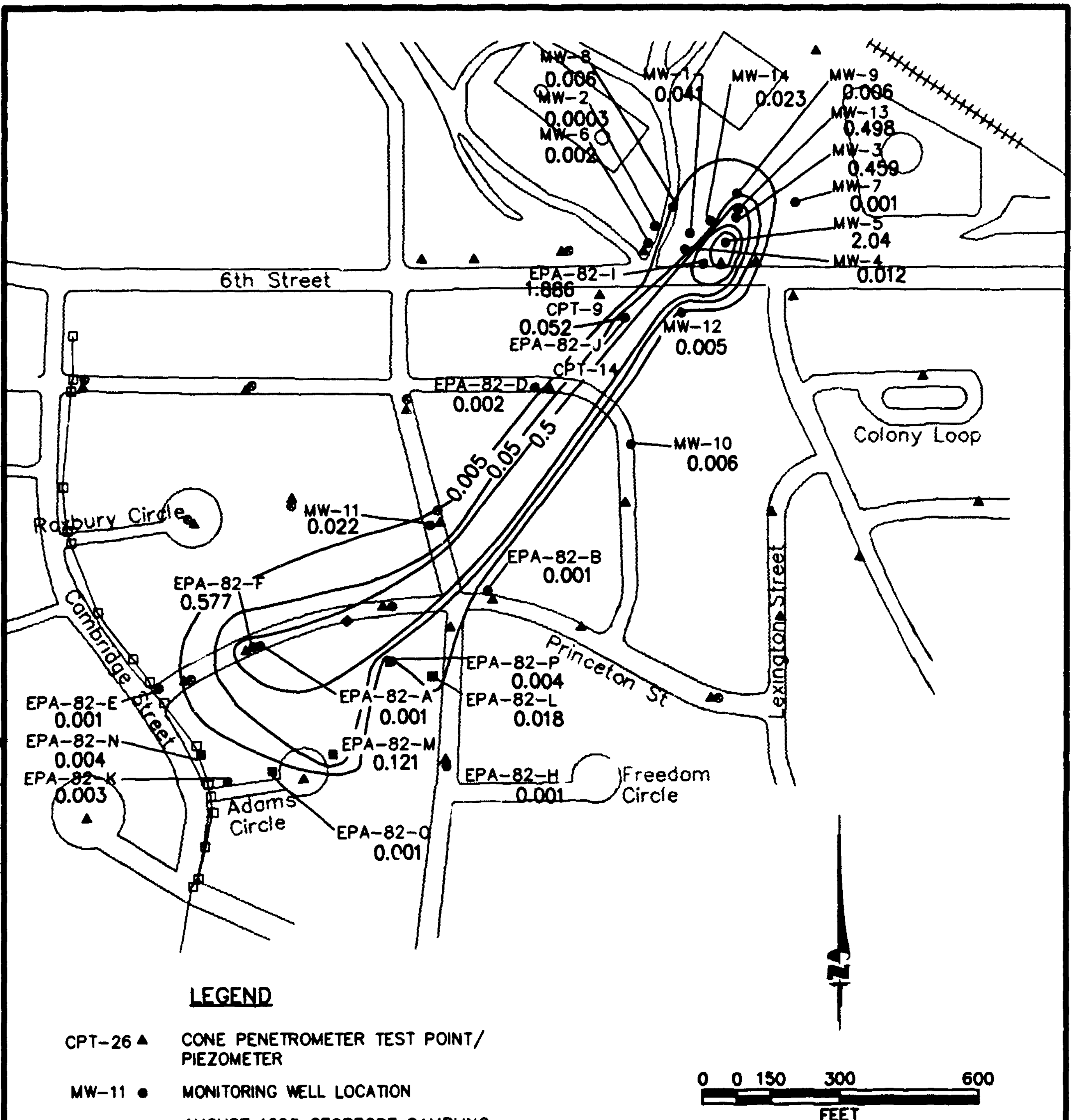


FIGURE 4.15

METHANE ISOPLETH FOR GROUNDWATER JULY 1994

UST Site 870
Intrinsic Remediation EE/CA
Hill Air Force Base, Utah

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

L:\45002\DRAWINGS\95DN0437, 3/17/95 at 11:30

LAYER: METHANE_1994

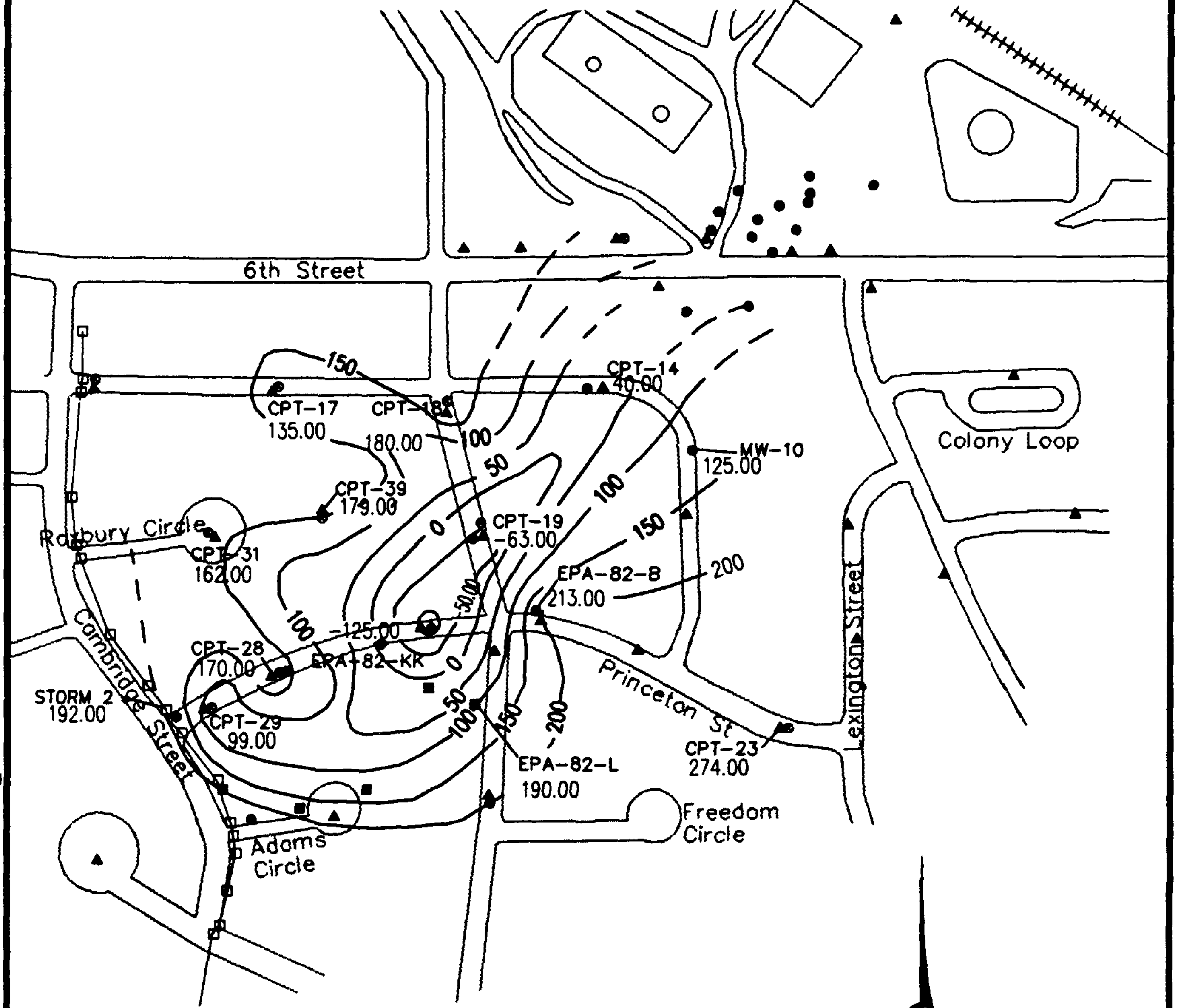
Therefore, 0.77 mg of methane is produced during biodegradation of 1 mg of benzene. Similar calculations can be completed for toluene (0.78 mg of methane produced during biodegradation of 1 mg of toluene), ethylbenzene (0.79 mg of methane produced during biodegradation of 1 mg of ethylbenzene), and the xylenes (0.79 mg of methane produced during biodegradation of 1 mg of xylene). The average mass ratio of methane produced during total BTEX biodegradation is thus 0.78:1. This means that approximately 1 mg of BTEX is mineralized for every 0.78 mg of methane produced. The highest measured methane concentration was 2.04 mg/L. This suggests that the shallow ground water at this site has the capacity to assimilate 2.6 mg/L (2,600 µg/L) of total BTEX during methanogenesis. Again, this is a very conservative estimate of the assimilative capacity of methanogenesis because microbial cell mass production is not taken into account by the stoichiometry shown above (see Section 4.3.2.1). In addition, these calculations are based on observed methane concentrations and not on the amount of carbon dioxide available in the aquifer. Therefore, methanogenic assimilative capacity could be much higher.

4.3.2.6 Reduction/Oxidation Potential

Redox potentials were measured at Geoprobe® locations and monitoring points/wells in August 1993, November 1993, December 1993/January 1994, and July 1994. Redox potential is a measure of the relative tendency of a solution to accept or transfer electrons. The redox potential of a groundwater system depends on which electron acceptor is being reduced by microbes during BTEX oxidation. The redox potential at UST Site 870 ranges from 274 millivolts (mV) to -137 mV. Table 4.5 summarizes available redox potential data. Figures 4.16 and 4.17 graphically illustrate the distribution of redox potentials in August 1993 and July 1994, respectively. Redox potential is decreased to a low value of -190 mV in MW-10. Areas at the site with low redox potentials coincide with areas with high BTEX contamination, low DO, nitrate, and sulfate concentrations, and elevated ferrous iron and methane concentrations (compare Figures 4.4 through 4.17). This suggests that dissolved BTEX at the site may be subjected to a variety of biodegradation processes including aerobic respiration, denitrification, iron reduction, sulfanogenesis, and methanogenesis.

4.3.2.7 Alkalinity

Total alkalinity (as $CaCO_3$) was measured at Geoprobe® locations and monitoring points/wells in August 1993, November 1993, December 1993/January 1994, and July 1994.



LEGEND

- CPT-26 ▲ CONE PENETROMETER TEST POINT/ PIEZOMETER
- MW-11 ● MONITORING WELL LOCATION
- ● AUGUST 1993 GEOPROBE SAMPLING LOCATION
- □ STORM DRAIN SURVEY LOCATION
- EPA-82-M ■ JULY 1994 GEOPROBE SAMPLING LOCATION
- EPA-82-KK ◆ JULY 1994 SOIL BORING LOCATION
- —100— LINE OF EQUAL OXIDATION-REDUCTION POTENTIAL (mV)

0 0 150 300 600
FEET

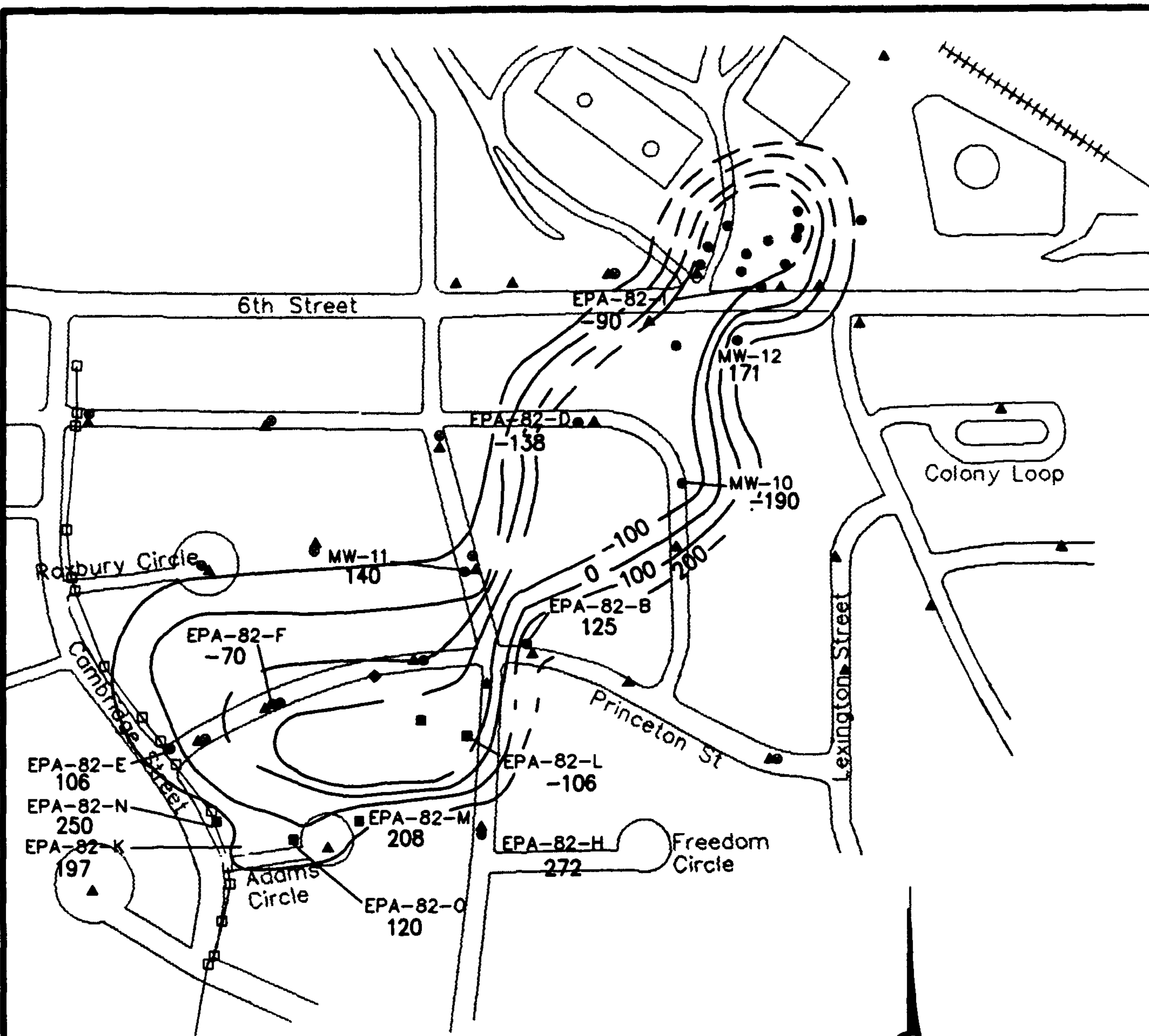
FIGURE 4.16

REDUCTION/OXIDATION POTENTIAL MAP AUGUST 1993

UST Site 870
Intrinsic Remediation EE/CA
Hill Air Force Base, Utah

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

L:\45002\DRAWINGS\95DN0436, 04/12/95 at 09:47 LAYER: REDOX_1993



LEGEND

CPT-26 ▲	CONE PENETROMETER TEST POINT/ PIEZOMETER
MW-11 ●	MONITORING WELL LOCATION
●	AUGUST 1993 GEOPROBE SAMPLING LOCATION
□	STORM DRAIN SURVEY LOCATION
EPA-82-M ■	JULY 1994 GEOPROBE SAMPLING LOCATION
EPA-82-KK ◆	JULY 1994 SOIL BORING LOCATION
—100—	LINE OF EQUAL REDOX POTENTIAL (mV) (DASHED WHERE INFERRED)

NOTE: UNLABELED WELL POINTS WERE NOT SAMPLED

0 0 150 300 600
FEET

FIGURE 4.17

REDUCTION/OXIDATION POTENTIAL MAP JULY 1994

UST Site 870
Intrinsic Remediation EE/CA
Hill Air Force Base, Utah

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

L:\45002\DRAWINGS\95DN0428, 04/12/95 at 09:52

These measurements are summarized in Table 4.5. Alkalinity is a measure of a ground water's ability to buffer changes in pH caused by the addition of biologically generated acids. Total alkalinity at the site is fairly high, and varies from 959 mg/L at EPA-82-D to 349 mg/L at EPA-82-E. This amount of alkalinity should be sufficient to buffer potential changes in pH caused by biologically mediated BTEX oxidation reactions.

4.3.2.8 pH

The pH was measured at Geoprobe® locations and monitoring points/wells in August, 1993, November 1993, December 1993/January 1994, and July 1994. These measurements are summarized in Table 4.5. The pH of a solution is the negative logarithm of the hydrogen ion concentration [H^+]. Ground water pH at UST Site 870 ranges from slightly acidic (6.3) to slightly basic (8.3). The majority of ground water has a pH of between 7.1 and 7.4. This range of pH is optimal for BTEX-degrading microbes.

4.3.2.9 Temperature

Ground water temperature was measured at Geoprobe® locations and monitoring points/wells in August 1993, November 1993, December 1993/January 1994, and July 1994. Table 4.5 summarizes ground water temperature readings. Temperature affects the types and growth rates of bacteria that can be supported in the ground water environment. Temperatures in the shallow saturated zone vary from 12.9 degrees Celsius (°C) to 25°.

4.3.3 Expressed Assimilative Capacity

The data presented in the preceding sections suggest that mineralization of BTEX compounds is occurring through the microbially mediated processes of aerobic respiration, denitrification, iron reduction, sulfanogenesis, and methanogenesis. Based on the stoichiometry presented in these sections, the expressed BTEX assimilative capacity of ground water at UST Site 870 is at least 31,370 µg/L (Table 4.6). The calculations presented in these earlier sections are extremely conservative because they do not account for microbial cell mass production. In addition, the measured concentrations of ferrous iron and methane may not be the maximum achievable. The highest plausible dissolved-phase total BTEX concentration observed at the site was 26,576 µg/L in monitoring well MW-03 in August 1992. The total BTEX concentration in this well in

December 1993/January 1994 was 9,466 μg/L. The highest total BTEX concentration observed in July 1994 was 21,475 μg/L.

Based on the calculations presented in the preceding sections, and on site observations, ground water at UST Site 870 has enough assimilative capacity to degrade dissolved-phase BTEX that partitions from the LNAPL plume into the ground water before the plume migrates 1,600 feet downgradient from the source area.

TABLE 4.6
EXPRESSED ASSIMILATIVE CAPACITY OF SITE GROUND WATER
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

Electron Acceptor or Process	Expressed BTEX Assimilative Capacity (μg/L)
Dissolved Oxygen	1,900
Nitrate	3,570
Ferric Hydroxide	2,300
Sulfate	21,000
Methanogenesis	2,600
Expressed Assimilative Capacity	31,370
Highest observed Total BTEX Concentration	26,576

SECTION 5

GROUND WATER MODEL

5.1 GENERAL OVERVIEW AND MODEL DESCRIPTION

In order to estimate degradation rates of dissolved-phase BTEX compounds at UST Site 870, and to help predict the future migration of these compounds, Parsons ES modeled the fate and transport of the dissolved-phase BTEX plume. The modeling effort had three primary objectives: 1) to predict the future extent and concentration of the dissolved-phase contaminant plume by modeling the combined effects of advection, dispersion, sorption, and biodegradation; 2) to assess the possible risk to potential downgradient receptors; and 3) to provide technical support for the natural attenuation remedial option at post-modeling regulatory negotiations. The model was developed using site-specific data and conservative assumptions about governing physical and chemical processes. Because of the conservative nature of model input, the reduction in contaminant mass caused by natural attenuation is expected to exceed model predictions. This analysis is not intended to represent a baseline assessment of potential risks posed by site contamination.

The Bioplume II computer model was used to estimate the potential for dissolved-phase BTEX migration and degradation by naturally-occurring mechanisms operating at UST Site 870. The Bioplume II model incorporates advection, dispersion, sorption, and biodegradation to simulate BTEX plume migration and degradation. The model is based upon the US Geological Survey Method of Characteristics (USGS MOC) two-dimensional (2-D) solute transport model of Konikow and Bredehoeft (1978). The model was modified by researchers at Rice University to include a biodegradation component that is activated by a superimposed DO plume. Based on the work of Borden and Bedient (1986), the model assumes a reaction between the DO and BTEX that is instantaneous relative to the advective ground water velocity. Bioplume II solves the USGS 2-D solute transport equation twice, once for hydrocarbon concentrations in the aquifer and once for a DO plume. The two plumes are combined using superposition at every particle move to simulate the instantaneous, biologically-mediated, reaction between hydrocarbons and oxygen. In recent years it has

become apparent that anaerobic processes such as nitrate reduction (denitrification), iron reduction, sulfate reduction (sulfanogenesis), and methanogenesis can be important BTEX degradation mechanisms (Grbic´-Galic´ and Vogel, 1987; Lovely *et al.*, 1989; Grbic´-Galic´, 1990; Hutchins, 1991; Beller *et al.*, 1992; Edwards *et al.*, 1992; Edwards and Grbic´-Galic´,1992). As with DO, the reaction between nitrate and BTEX can be assumed to be instantaneous relative to the ground water flow velocity (Wilson, 1994). The Bioplume II model does not allow direct input of nitrate concentrations. Because of this, nitrate concentrations were input as DO-equivalent concentrations. The use of nitrate in this manner allowed the Bioplume II model to more accurately simulate rates of biodegradation at the site. The use of nitrate as a model input parameter is discussed in Section 5.4.5. The following sections discuss in more detail the model setup, input parameters and assumptions, model calibration, and simulation results.

5.2 CONCEPTUAL MODEL DESIGN AND ASSUMPTIONS

Prior to developing a ground water model, it is important to determine if sufficient data are available to provide a reasonable estimate of aquifer hydraulic and geochemical conditions. In addition, it is important to ensure that any limiting assumptions can be justified. The most important assumption made when using the Bioplume II model is that oxygen-limited (and in this case, oxygen/nitrate-limited) biodegradation is occurring at the site. The Bioplume II model assumes that the limiting factors for biodegradation are: 1) the presence of an indigenous hydrocarbon degrading microbial population, and 2) sufficient background electron acceptor concentrations. Data presented in Sections 3 and 4 indicate that oxygen, nitrate, ferric hydroxide, sulfate, and carbon dioxide (methanogenesis) are all being used for aerobic and anaerobic biodegradation. To be conservative, only oxygen and nitrate are used as electron acceptors in the instantaneous reaction simulated by the Bioplume II model presented herein. To model biodegradation with DO and nitrate as electron acceptors, the isopleth maps for these compounds were superimposed and combined to form a "total" electron acceptor isopleth map. These data were then used for model input.

Based on the data presented in Section 3, the shallow saturated zone was conceptualized and modeled as a shallow unconfined aquifer comprised of medium-grained, moderately sorted sands (Figures 3.3 and 3.4.). With the exception of limited mobile LNAPL removal and bioventing in the spill area, contaminated soils at the site have not been remediated.

Additional mobile and residual LNAPL removal would further reduce the continuing source of dissolved-phase BTEX contamination at the site. Several model simulations were conducted; both with LNAPL as a continuing source and with the LNAPL removed through time. Because of the low residual-phase BTEX concentrations observed in soils outside of areas containing mobile LNAPL, it was assumed that these soils represent a minimal source of continuing BTEX contamination. The use of a two-dimensional model is appropriate at Site UST 870 because the saturated interval is thin (generally less than 3 feet) and a relatively impermeable clayey silt and silty clay confining layer directly underlies the saturated zone. In addition, vertical ground water gradients at the site are upward, as is common over much of the Great Salt Lake Basin.

5.4 MODEL INPUT

Input parameters used for this model are based on a review of existing site data and a review of the pertinent literature. Where site-specific data were not available, reasonable assumptions for the types of materials comprising the shallow saturated zone were made based on widely accepted literature values. Table 5.1 lists the input parameters used for the modeling effort. Appendix D contains gridded data used as model input. Model output is presented in Appendix E as a diskette in ASCII format. The following sections describe the Bioplume II model parameters that have the greatest influence on model predictions.

5.4.1 Grid Design

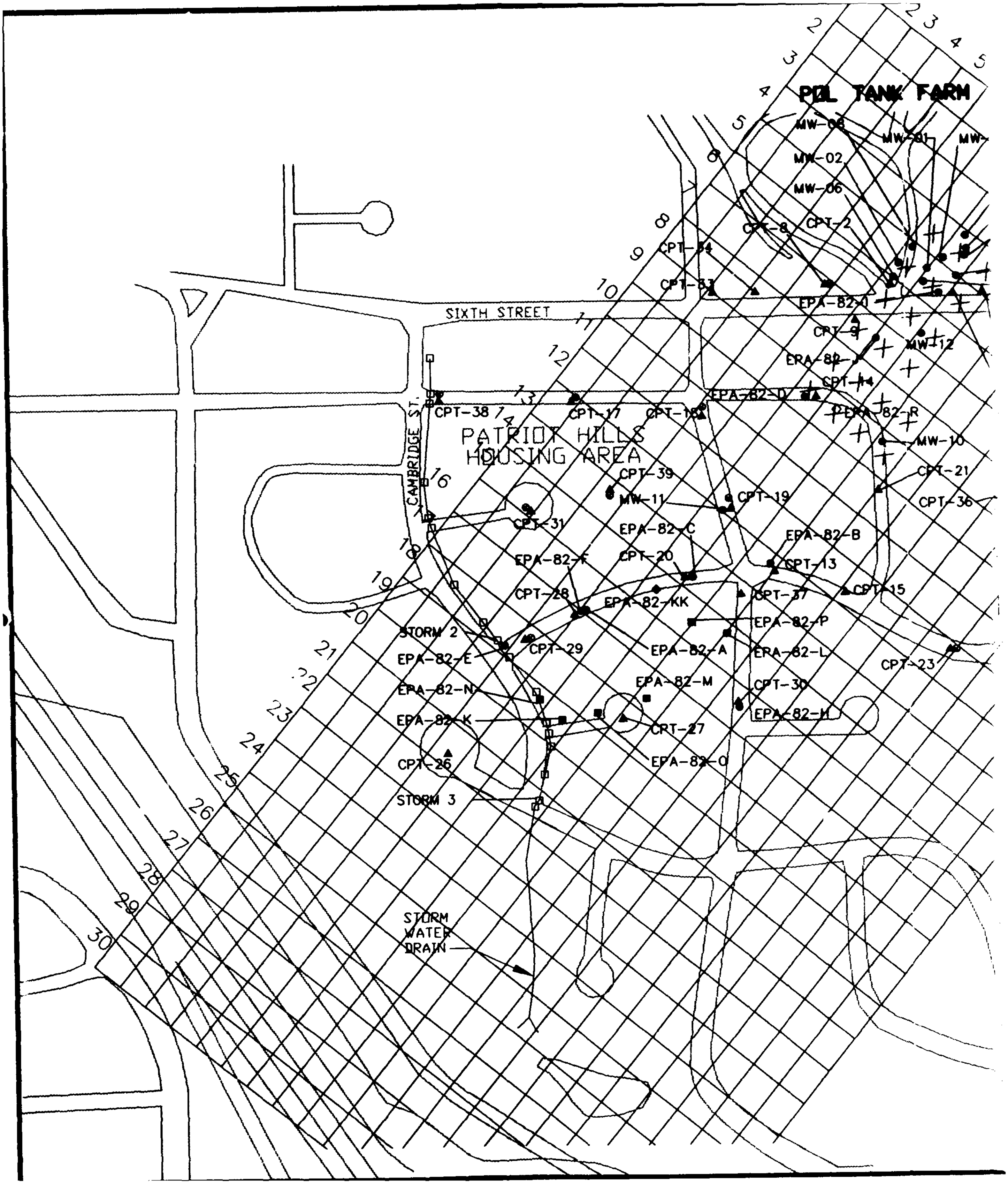
The maximum grid size for the Bioplume II model is limited to 20 columns by 30 rows. The dimension of each column and row can range from 0.1 to 999.9 feet. A 20- by 30-cell grid was used to model the Hill AFB site. Each grid cell was 110 feet long by 85 feet wide. The grid was oriented so that the longest cell dimension was parallel to the direction of ground water flow (Figure 5.1). The model grid covers an area of 5.6 million square feet, or approximately 129 acres.

Constant-head boundaries were established along the northeast and southwest perimeter of the model grid to simulate the southwestern flow of ground water observed at the site. These constant-head cells were placed at a sufficient distance from the BTEX plume to avoid potential boundary interferences. Injection cells were used to simulate the

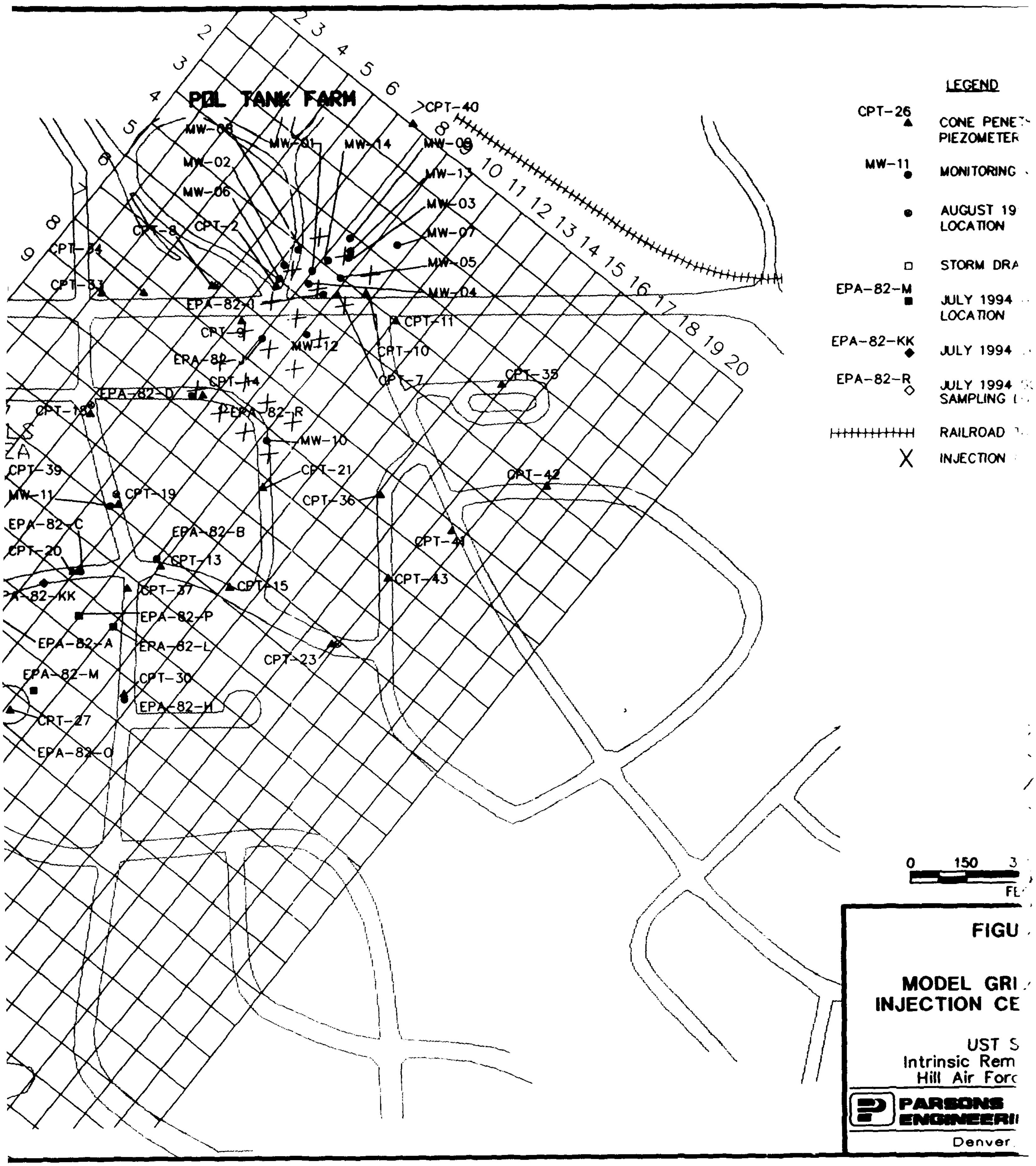
TABLE 5.1
BIOPLUME II MODEL INPUT PARAMETERS
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

Parameter	Description	Calibrated Model Setup	Hill-A	Hill-B	Hill-C
NTIM	Max. number of time steps in a pumping period		15	2	2
NPMP	Number of Pumping Periods		1	25	12
NX	Number of nodes in the X direction		20	20	20
NY	Number of nodes in the Y direction		30	30	30
NPMAX	Maximum number of Particles NPMAX=(NX-2)(NY-2)(NPTPND) + (Ne)(NPTPND) + 250		5290	5290	5290
NPNT	Time step interval for printing data	1	1	1	1
NITP	Number of iteration parameters	7	7	7	7
NUMOBS	Number of observation points		5	5	5
ITMAX	Maximum allowable number of iterations in ADIP	200	200	200	200
NREC	Number of pumping or injection wells		20	0	0
NPTPND	Initial number of particles per node	9	9	9	9
NCODES	Number of node identification codes		2	2	2
NPNTMV	Particle movement interval (IMOV)	0	0	0	0
NPNTVL	Option for printing computed velocities	2	1	1	1
NPNTD	Option to print computed dispersion equation coefficients	2	1	1	1
NPDELC	Option to print computed changes in concentration	1	1	1	1
NPNCHV	Option to punch velocity data	0	0	0	0
NREACT	Option for biodegradation, retardation and decay	1	1	1	1
PINT	Pumping period (years)		15	1	1
TOL	Convergence criteria in ADIP	0.001	0.001	0.001	0.001
POROS	Effective porosity		0.25	0.25	0.25
BETA	Characteristic length (long. dispersivity; feet)		53.4	53.4	53.4
S	Storage Coefficient	0 (Steady-State)	0	0	0
TIMX	Time increment multiplier for transient flow		NA	NA	NA
TINIT	Size of initial time step (seconds)		NA	NA	NA
XDEL	Width of finite difference cell in the x direction (feet)		85	85	85
YDEL	Width of finite difference cell in the y direction (feet)		110	110	110
DLTRAT	Ratio of transverse to longitudinal dispersivity	0.1	0.1	0.1	0.1
CELDIS	Maximum cell distance per particle move	0.5	1	0.5	0.5
ANFCTR	Ratio of Tyy to Txx	1 (Isotropic)	1	1	1
DK	Distribution coefficient		.05451	.05451	.05451
RHOB	Bulk density of the solid (grams/cubic centimeter)		1.6	1.6	1.6
THALF	Half-life of the solute		0	0	0
DEC1	Anaerobic decay coefficient		0	0	0
DEC2	Reaeration coefficient (day^{-1})		.003	.003	.003

NA = Not Applicable



POL TANK FARM
MW-03
MW-01
MW-02
MW-06
CPT-8
CPT-2
CPT-34
CPT-33
SIXTH STREET
EPA-82-I
CPT-9
MW-12
EPA-82-J
CPT-14
EPA-82-D
CPT-38
CPT-17
CPT-18
EPA-82-R
CAMBRIDGE ST.
PATRIOT HILLS
HOUSING AREA
MW-10
CPT-21
CPT-39
CPT-36
MW-11
CPT-19
CPT-31
EPA-82-C
EPA-82-B
EPA-82-F
CPT-20
CPT-13
CPT-28
EPA-82-KK
CPT-37
CPT-15
STORM 2
EPA-82-P
CPT-29
EPA-82-A
EPA-82-L
EPA-82-E
CPT-23
EPA-82-M
EPA-82-N
CPT-30
EPA-82-H
EPA-82-K
CPT-27
CPT-26
EPA-82-O
STORM 3
STORM
WATER
DRAIN


POL TANK FARM
MW-08
MW-01
MW-14
MW-09
MW-02
MW-13
MW-06
MW-03
MW-07
MW-05
MW-04
CPT-40
CPT-8
CPT-2
CPT-34
CPT-33
EPA-82-I
CPT-9
CPT-11
MW-12
EPA-82-J
CPT-10
CPT-14
CPT-7
CPT-35
EPA-82-D
CPT-18
EPA-82-R
MW-10
CPT-39
CPT-21
CPT-42
MW-11
CPT-19
CPT-36
EPA-82-C
EPA-82-B
CPT-41
CPT-20
CPT-13
CPT-43
CPT-37
CPT-15
EPA-82-P
EPA-82-A
EPA-82-L
CPT-23
EPA-82-M
CPT-30
EPA-82-H
CPT-27
EPA-82-O
LEGEND
CPT-26
CONE PENE
PIEZOMETER
MW-11
MONITORING
AUGUST 19
LOCATION
STORM DRA
EPA-82-M
JULY 1994
LOCATION
EPA-82-KK
JULY 1994
EPA-82-R
JULY 1994
SAMPLING
RAILROAD
INJECTION
0
150
FIGU
MODEL GRI
INJECTION CE
UST S
Intrinsic Rem
Hill Air Forc
PARSONS
ENGINEERI
Denver

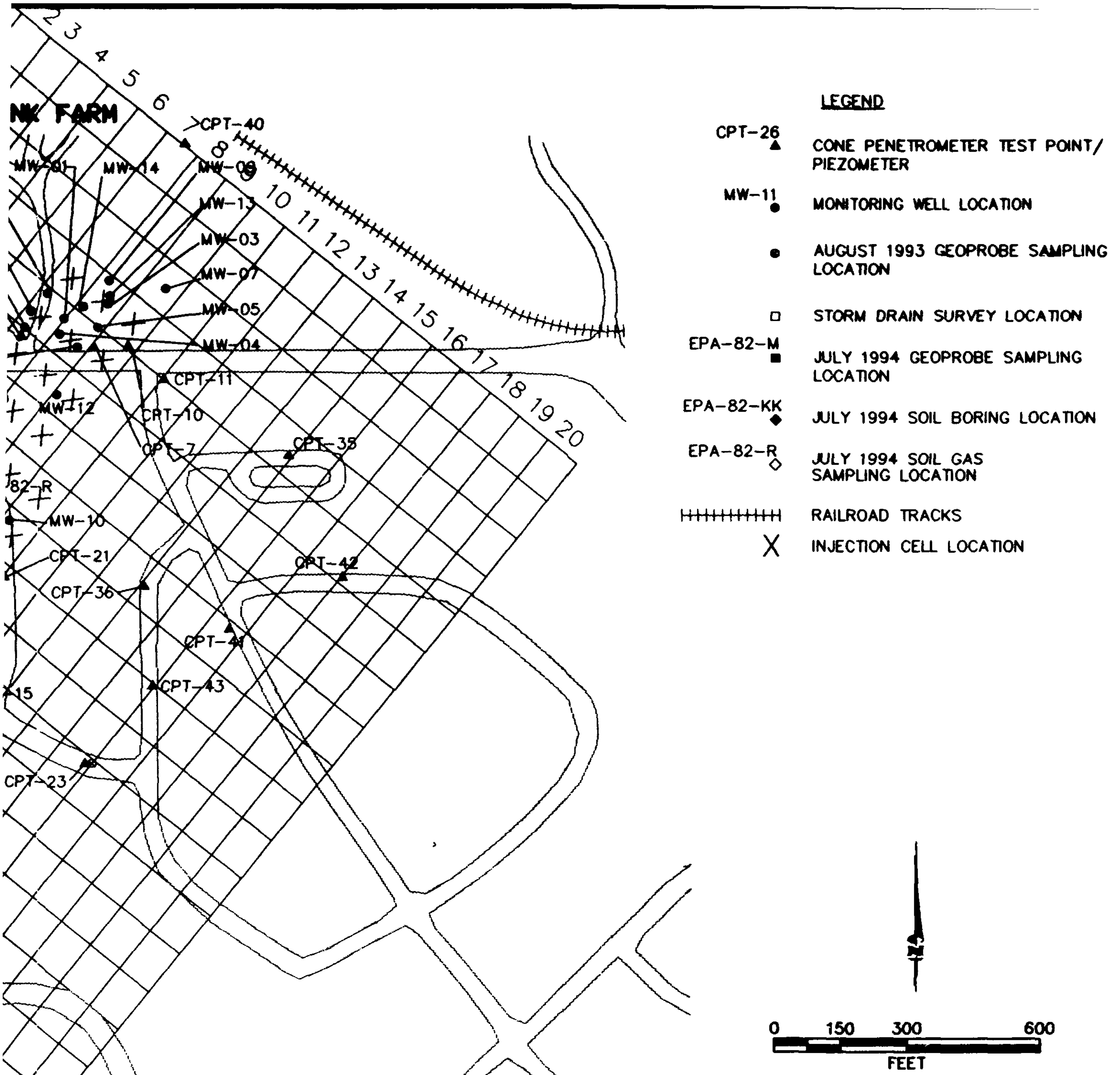


FIGURE 5.1

MODEL GRID INCLUDING INJECTION CELL LOCATIONS

UST Site 870
Intrinsic Remediation EE/CA
Hill Air Force Base, Utah

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

continuing source of contamination caused by the mobile LNAPL present at the site. Injection well locations are shown in Figure 5.1 and are explained in detail in Section 5.5.

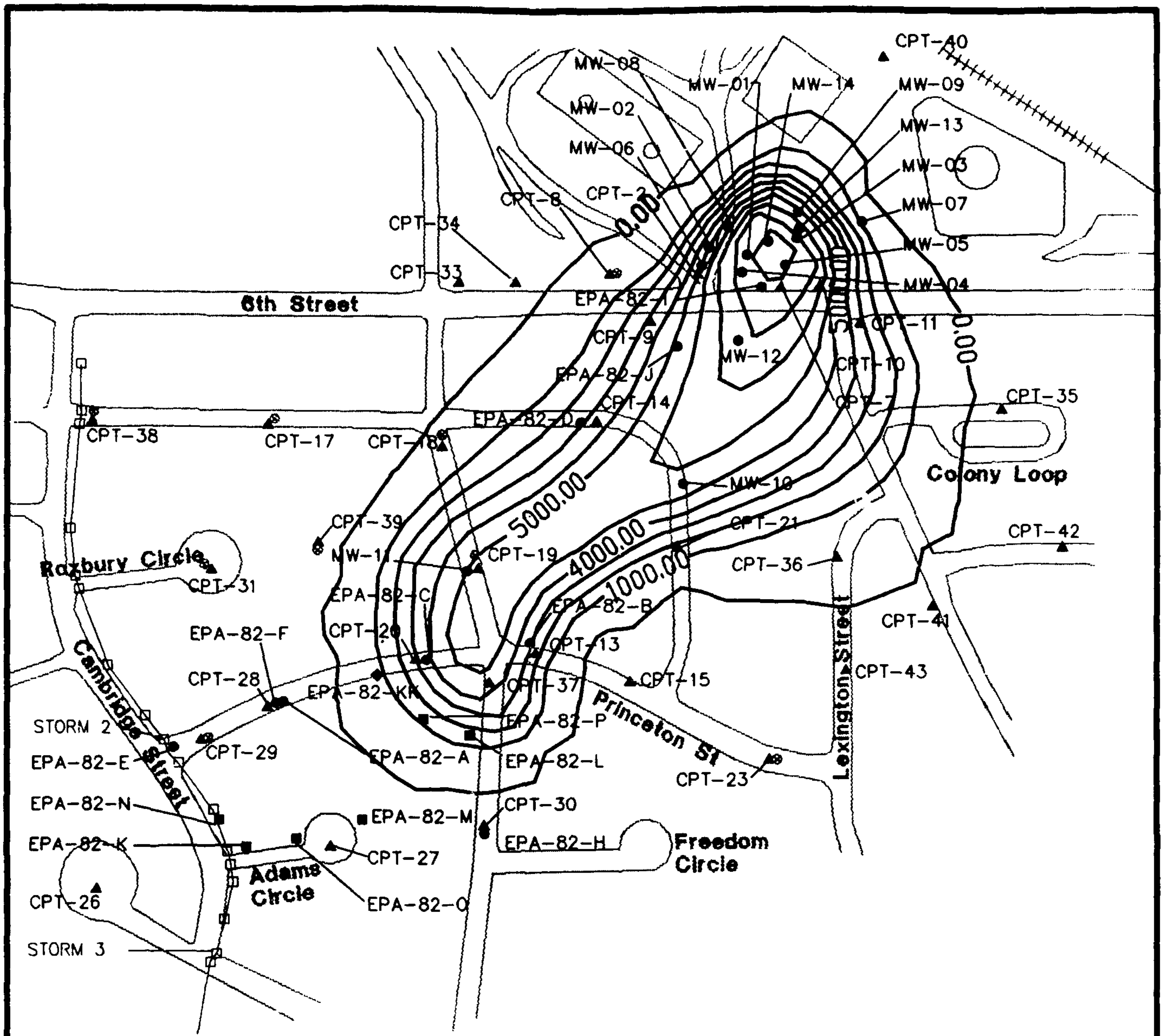
5.4.2 Ground Water Elevation and Gradient

The water table elevation data presented in Figure 3.5 were used as Bioplume II model input. Available site data suggest that there is almost no seasonal variation in ground water flow direction or gradient at the site (Appendix B and MWI, 1994). Ground water flow in the vicinity of UST Site 870 is to the southwest at an average gradient of approximately 0.048 ft/ft between wells EPA-82-I and EPA-82-E. As described in Section 5.5, the ground water flow model was calibrated to the observed water table.

5.4.3 BTEX Concentrations

The highest total-dissolved BTEX concentrations obtained from laboratory analytical data for the period through August 1993 were used for model development. Figure 4.4 shows the spatial distribution of the highest (most conservative) dissolved-phase BTEX compounds detected through August 1993. Table 4.4 contains dissolved BTEX concentration data. Appendix D contains the gridded total BTEX concentrations used as model input.

The BTEX data from Figure 4.4 was used in model development by placing the model grid over the isopleth contours. The total BTEX concentration used in the model, and shown in Appendix D, is an estimated average concentration of all the isopleth lines intersecting the boundaries within each model cell. The highest concentration isopleth lines were not used for allocating BTEX concentrations to model cells because a single isopleth concentration was not representative of the average total BTEX concentrations over the entire 85 feet by 110 feet model cell. Figure 5.2 shows the distribution of the BTEX plume as calculated by the Bioplume II model for T=0 for all models. Comparison of Figures 4.4 and 5.2 shows that there is good agreement between the actual BTEX distribution in the shallow saturated zone and the initial distribution calculated by the Bioplume II model. The initial BTEX plume covers an area of approximately 650,000 square feet (15 acres). The shape and distribution of the total BTEX plume is the result of advective transport of dissolved-phase BTEX contamination downgradient from the LNAPL contamination present in the source area.



LEGEND

CPT-26 ▲	CONE PENETROMETER TEST POINT/ PIEZOMETER
MW-11 ●	MONITORING WELL LOCATION
⊗	AUGUST 1993 GEOPROBE SAMPLING LOCATION
▫	STORM DRAIN SURVEY LOCATION
EPA-82-M	JULY 1994 GEOPROBE SAMPLING
EPA-82-KK ◆	JULY 1994 SOIL BORING LOCATION
—1000—	LINE OF EQUAL TOTAL BTEX CONCENTRATION (μg/L)
	CONTOUR INTERVAL = 1,000 μg/L

FIGURE 5.2

MODEL RESULTS
TOTAL DISSOLVED BTEX
ALL MODELS
T=0 YEAR

UST Site 870
Intrinsic Remediation EE/CA
Hill Air Force Base, Utah

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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LAYER: HAO

Partitioning of BTEX compounds from the LNAPL into the ground water is described in Section 5.5.

5.4.4 Hydraulic Conductivity

Hydraulic conductivity (K) is an important aquifer characteristic that determines the ability of the water-bearing strata to transmit ground water. An accurate estimate of this parameter is important to help quantify advective ground water flow velocities, to define the flushing potential of the aquifer, and to estimate the quantity of electron-acceptor-rich ground water that is entering the site from upgradient locations. Rifai *et al.* (1988) report that the Bioplume II model is particularly sensitive to variations in hydraulic conductivity. Lower values of hydraulic conductivity result in a slower-moving plume that degrades at a slower rate because less oxygen and nitrate are available for biodegradation. Higher values of hydraulic conductivity result in a faster moving plume that degrades at a faster rate because more oxygen and nitrate are available for biodegradation.

Based on slug tests performed at the site, hydraulic conductivity varies from 1.08×10^{-4} ft/s to 6.08×10^{-4} ft/s. This is within the accepted range for sandy materials (Freeze and Cherry, 1979). Slug test results used for modeling do not reflect slug test data collected by JMM (1993) at MW-1. MW-1 was screened in a soil interval characterized by silty sands with a large interval (~4 ft) of clayey sand. As a result, slug test data from MW-1 was not considered representative of the fine- to medium- grained sandy soils located around the screened monitoring wells used for Parsons ES slug tests in 1993. The sensitivity of the model to this parameter was evaluated during the sensitivity analysis described in Section 5.6.

5.4.5 Electron Acceptors (Oxygen and Nitrate)

As discussed previously, the Bioplume II model assumes an instantaneous reaction between the BTEX plume and the electron acceptors. As discussed in Section 4, it is apparent that DO, nitrate, ferric hydroxide, sulfate and carbon dioxide (methanogenesis) are being used as electron acceptors for biodegradation of BTEX compounds at UST Site 870. However, to be conservative, the total BTEX plume at UST Site 870 was modeled assuming that oxygen and nitrate were the only electron acceptors being utilized at a rate that is instantaneous relative to the advective ground water velocity for the biodegradation of the BTEX compounds.

The Bioplume II model was calibrated with DO as the only electron acceptor. The result of using DO as the only electron acceptor was a modeled BTEX plume that extended nearly twice as far (and past the Hill AFB boundary) downgradient than the plume observed in 1994. Based on these results, it was clear that DO is not the only electron acceptor being utilized for BTEX biodegradation. Successful calibration of the Bioplume II model required the use of nitrate, which is the most thermodynamically favorable electron acceptor following oxygen. Furthermore, decreases in nitrate concentrations from anaerobic biodegradation processes were observed in areas with reduced DO concentrations (compare Figures 4.6 and 4.7 with Figures 4.8 and 4.9, respectively). This strongly suggests both denitrification and aerobic oxidation are important biodegradation mechanisms at the site. Although some localized areas on the fringe of the BTEX plume overestimated the actual rate of denitrification because of background DO concentrations, both aerobic oxygenation and denitrification of BTEX contamination were widely observed in the same areas. Therefore, simulating nitrate concentrations with DO concentrations in the model was not an overgeneralization of site electron acceptor potential (as might initially be presumed), but instead was an improved representation of site conditions. Related modeling initiatives to improve simulations of BTEX biodegradation in ground water systems are being accomplished by incorporating nitrate, and other potential anaerobic electron acceptors (e.g., ferric iron, sulfate, and carbon dioxide) into the model code, specifically within the code of the soon-to-be released Bioplume III ground water model (Rifai, 1995).

The loss of DO and nitrate in the Bioplume II model was conceptualized with aerobic bacteria using DO, and then with anaerobic bacteria using nitrate as the next available electron acceptor. This assumption is justified based on the observation that aerobic oxidation and denitrification are important biodegradation mechanisms at the site. Once utilized, DO and nitrate will react instantaneously with BTEX relative to the advective groundwater velocity in the aquifer (Borden and Bedient, 1986; Wilson, 1994).

Ground water samples collected in uncontaminated portions of the aquifer indicate that background DO concentrations at the site are about 6.3 mg/L. To be conservative, background DO concentrations were assumed to be 5.0 mg/L for Bioplume II model development. Table 4.5 contains DO data for the site. Figures 4.6 and 4.7 are DO isopleth maps. Gridded oxygen input data are included in Appendix D.

Ground water samples collected in uncontaminated portions of the aquifer indicate that background nitrate (as N) concentrations at the site may be as high as 17 mg/L. However, to be conservative, nitrate (as N) concentrations around the periphery of the plume were assumed to be 5 mg/L for Bioplume II model development. Table 4.5 contains nitrate data for the site. Figures 4.8 and 4.9 are nitrate isopleth maps. Gridded nitrate data are included in Appendix D.

The upgradient constant-head cells in the Bioplume II model require background electron acceptor concentrations to be input as constant concentrations to simulate incoming electron acceptors. To be conservative, a DO concentration of 5 mg/L and a nitrate (as N) concentration of 10 mg/L was used for these cells.

Bioplume II® is capable of tracking only a single electron acceptor as an instantaneous reaction in model simulations (customarily DO) for estimating BTEX biodegradation. Consequentially, the model cannot estimate both DO and nitrate biodegradation mechanisms simultaneously unless one electron acceptor is mathematically converted to an equivalent form of the other. Denitrifying conditions were modeled by converting nitrate concentrations to equivalent oxygen concentrations. On a mass basis, 4.77 mg of ionic nitrate are required to oxidize 1 mg of benzene, whereas, only 3.08 mg of DO are required to oxidize the same mass of benzene. Hence, ionic nitrate has only 64.6 percent of the capacity to biodegrade benzene that DO does. Converted ionic nitrate concentrations were combined with DO concentrations for a total oxygen/ionic nitrate electron acceptor map. The calculations used to convert nitrate (as N) to oxygen equivalent ionic nitrate are discussed below.

Nitrate concentrations at UST Site 870 were reported together with nitrite concentrations as nitrate + nitrite (as N) by RSKERL. Based on these data it is not possible to determine the relative amounts of nitrate and nitrite (as N); however, because nitrite is considered metastable in the ground water environment, it was assumed that the combined nitrate + nitrite (as N) value was all nitrate (as N). The work of von Gunten and Zobrist (1993) supports this assumption as does site-specific data (Table 4.5). These workers conducted column experiments using nitrate as an electron acceptor and noted that only small amounts of nitrite were detected in the column in the early stages of the experiment, and after 20 days, nitrite was no longer detected.

The use of nitrate as an electron acceptor requires that nitrate (as N) concentrations be converted to ionic nitrate concentrations. To do this, the equivalent weight of oxygen must be added back to the nitrate (as N) concentration:

Molecular weight of N = 14 gm/mole
Molecular weight of O = 16 gm/mole
Molecular weight of NO_3^- = 62 gm/mole

The percentage of N in NO_3^- is 14/62 = 22.58 percent. Therefore, 1 gm of NO_3^- (as N) is ·alent to 1/0.2258 = 4.43 gm of ionic NO_3^-. To convert nitrate (as N) into ionic nitrate :entrations, the measured nitrate (as N) concentration must be multiplied by 4.43.

Assuming complete mineralization of benzene to carbon dioxide and water, the reactions for aerobic respiration and denitrification are as follow:

Aerobic Respiration

$$C_6H_6 + 7.5O_2 = 6CO_2 + 3H_2O$$

Denitrification

$$6NO_3^- + 6H^+ + C_6H_6 = 6CO_2 + 6H_2O + 3N_{2(g)}$$

Based on this stoichiometry, 7.5 moles of DO are required to biodegrade 1 mole of benzene, and 6 moles of nitrate are required to biodegrade 1 mole of benzene. On a mass basis:

$$(7.5 \text{ moles } O_2)(32 \text{ gm/mole } O_2) = 240 \text{ gm } O_2$$

$$(6 \text{ moles } NO_3^-)(62 \text{ gm/mole } NO_3^-) = 372 \text{ gm } NO_3^-$$

From these relationships, it is apparent that, on a mass basis, more ionic nitrate than DO is required to oxidize a unit mass of benzene. By dividing the mass of ionic nitrate required to degrade one mole of benzene by the mass of DO required to degrade one mole of benzene, a ratio is derived that can be applied to ionic nitrate concentrations to obtain equivalent oxygen concentrations. This ratio is:

$$240 \text{ gm } O_2/372 \text{ gm } NO_3^- = 0.645 \text{ gm of } O_2 \text{ equivalent per gram of } NO_3^-$$

Therefore, 10 gm of NO_3^- has an O_2 equivalence of:

$$(10 \text{ gm } NO_3^-)(0.645 \text{ gm of } O_2 \text{ equivalent/gm of } NO_3^-) = 6.45 \text{ gm}$$

From these relationships, the following calculation must be performed to convert NO_3^- (as N) to an equivalent DO concentration:

$$(NO_3^-(\text{as N}) \text{ (gm/L)})(4.43 \text{gm } NO_3^- \text{ (ion)/gm } NO_3^-(\text{as N}))(0.65 \text{ gm } O_2 \text{ eq./gm } NO_3^-)$$

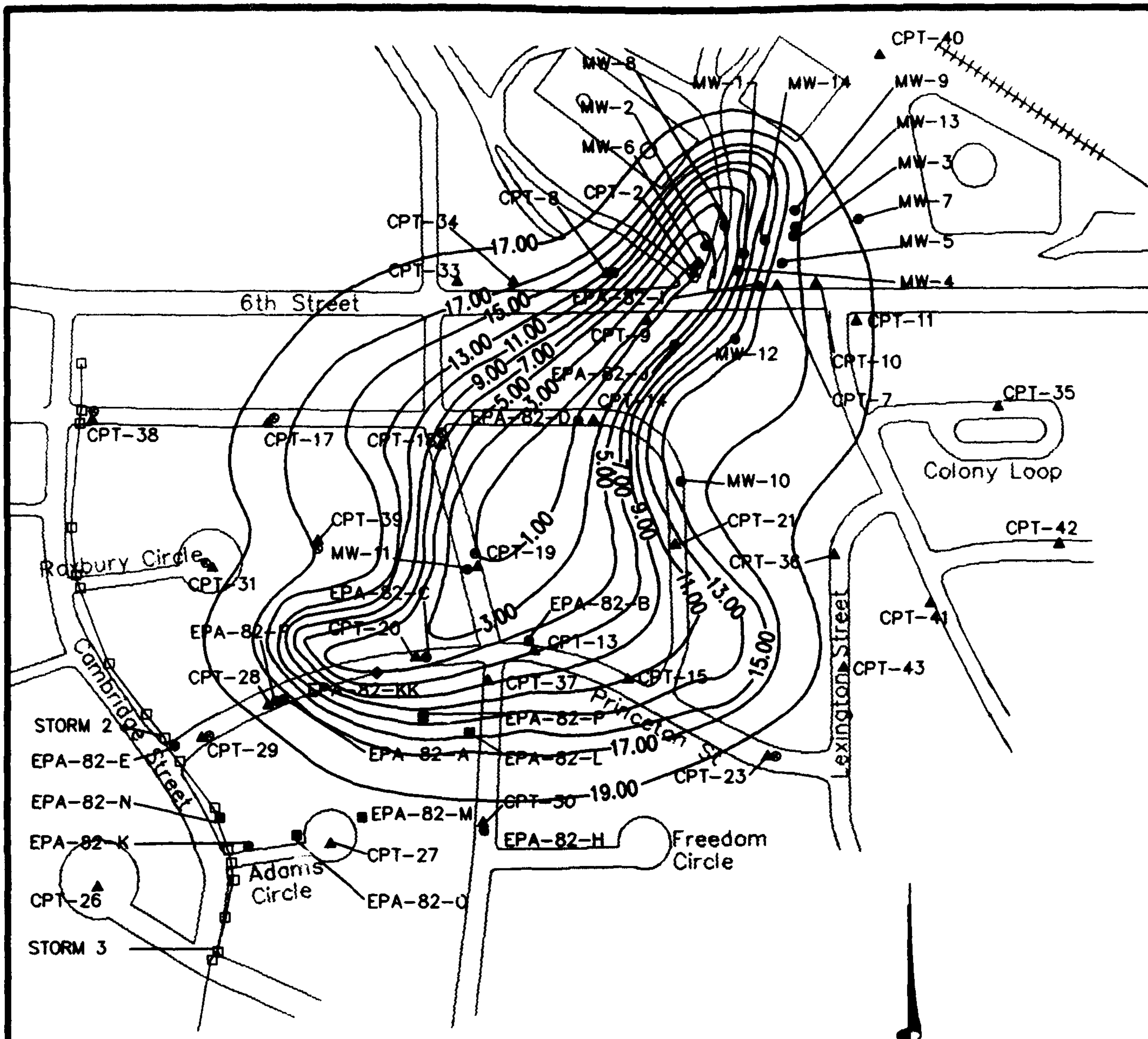
This relationship was used to convert measured nitrate (as N) concentrations into oxygen-equivalent ionic nitrate concentrations. To do this an isopleth map of nitrate (as N) was prepared and gridded. Gridded values of nitrate (as N) were then used in the relationship presented above to determine ionic NO_3^- as DO equivalence. These values were then added to existing DO concentrations previously gridded at the site and used as input into the Bioplume II model. Figure 5.3 shows the combined DO and NO_3^- (as DO equivalent concentrations) electron acceptor concentrations used in the Bioplume II model.

5.4.5 Dispersivity

Much controversy surrounds the concepts of dispersion and dispersivity. Longitudinal dispersivity values for alluvial sediments range from 0.1 to 200 feet (Walton, 1988). A longitudinal dispersivity of 53.4 feet was used in this model. This dispersivity was estimated by using one-tenth of the distance between the spill source and the longitudinal centroid of the plume. Transverse dispersivity values generally are at least one order of magnitude less than values of longitudinal dispersivity (Domenico and Schwartz, 1990). For this model, Parsons ES used 0.1 for the ratio of transverse dispersivity to longitudinal dispersivity. Use of an estimated value for dispersivity is appropriate because the Bioplume II model exhibits a weak sensitivity to dispersivity (Rifai *et al.*, 1988). In addition, the sensitivity of the model to the parameter was evaluated during the sensitivity analyses described in Section 5.6.

5.4.6 Retardation

Retardation of the BTEX compounds relative to the advective velocity of the ground water occurs when BTEX molecules are sorbed to the aquifer matrix. Based on measured TOC concentrations in an uncontaminated portion of the shallow saturated zone, and assuming a bulk density of 1.6 grams per cubic centimeter (gm/cc) (Freeze and Cherry, 1979), and



LEGEND

CPT-26 ▲ CONE PENETROMETER TEST POINT/ PIEZOMETER

MW-11 ● MONITORING WELL LOCATION

● AUGUST 1993 GEOPROBE SAMPLING LOCATION

□ STORM DRAIN SURVEY LOCATION

EPA-82-M ■ JULY 1994 GEOPROBE SAMPLING LOCATION

EPA-82-KK ◆ JULY 1994 SOIL BORING LOCATION

1000 — LINE OF EQUAL NITRATE CONCENTRATION (mg/L)

CONTOUR INTERVAL = 1 mg/L

FIGURE 5.3

COMBINED DO AND NITRATE ISOPLETH FOR GROUNDWATER AUGUST 1993

UST Site 870
Intrinsic Remediation EE/CA
Hill Air Force Base, Utah

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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published values of K_{oc} for the BTEX compounds (Martel, 1987), the coefficient of retardation for the BTEX compounds was calculated. The results of these calculations are summarized in Table 5.2. To be conservative, the minimum coefficient of retardation calculated for benzene (1.29) was used as model input.

5.4.7 Reaeration

The reaeration coefficient is a first-order decay rate constant used by Bioplume II to simulate the replenishment of oxygen into the ground water by soil gas diffusion and rainwater infiltration. Recent data on first-order biodegradation rate coefficients in groundwater at Hill AFB suggest that biodegradation rates ranged from 0.010 to 0.032 day^{-1} over the center and periphery of the groundwater contaminant plume (Wiedemeier *et al.*, 1994). To be conservative, a first-order biodegradation rate coefficient of 0.003 day^{-1} was used in this model. This rate coefficient was increased and decreased by one order of magnitude during the sensitivity analyses described in Section 5.6.

5.5 MODEL CALIBRATION

Model calibration is an important component in the development of any numerical ground water model. Calibration of the flow model demonstrates that a model is capable of matching hydraulic and chemical conditions observed in the field. The numerical model presented herein was calibrated by altering hydraulic parameters, boundary conditions, and stresses (i.e., injection cells) in a trial-by-error fashion until simulated heads and BTEX plumes approximated observed field conditions.

5.5.1 Water Table Calibration

The shallow water table at UST Site 870 was assumed to be influenced only by continuous recharge and discharge at the constant-head cells established at the upgradient and downgradient model boundaries. To be conservative, annual recharge of the aquifer through rainfall was not included in the model. Potential recharge by leaky stormwater sewers, collection ponds, or other sources was omitted because of a lack of reliable data. Only the

TABLE 5.2

RETARDATION CALCULATIONS FOR THE BTEX COMPOUNDS
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

Compound	K_{oc} (L/kg [a])	Maximum Fraction Organic Carbon [b]	Minimum Fraction Organic Carbon [b]	Average Fraction Organic Carbon [b]	Distribution Coefficient (L/kg)		Bulk Density (kg/L) [d]	Effective Porosity	Coefficient of Retardation	
					Maximum [c1]	Minimum [c2]			Maximum	Minimum
Benzene	79	0.00094	0.00069	0.00859	0.074	0.055	1.60	0.30	1.40	1.29
Toluene	190	0.00094	0.00069	0.00859	0.179	0.131	1.60	0.30	1.95	1.70
Ethylbenzene	468	0.00094	0.00069	0.00859	0.440	0.323	1.60	0.30	3.35	2.72
m-xylene	405	0.00094	0.00069	0.00859	0.381	0.279	1.60	0.30	3.03	2.49
o-xylene	422	0.00094	0.00069	0.00859	0.397	0.291	1.60	0.30	3.12	2.55
p-xylene	357	0.00094	0.00069	0.00859	0.336	0.246	1.60	0.30	2.79	2.31

NOTES:

[a] From technical protocol document (Wiedemeier *et al.*, 1994).

[b] From Upper Naknek data.

[c1] K_d = Maximum Fraction Organic Carbon x K_{oc}.

[c2] K_d = Minimum Fraction Organic Carbon x K_{oc}.

[d] Literature values.

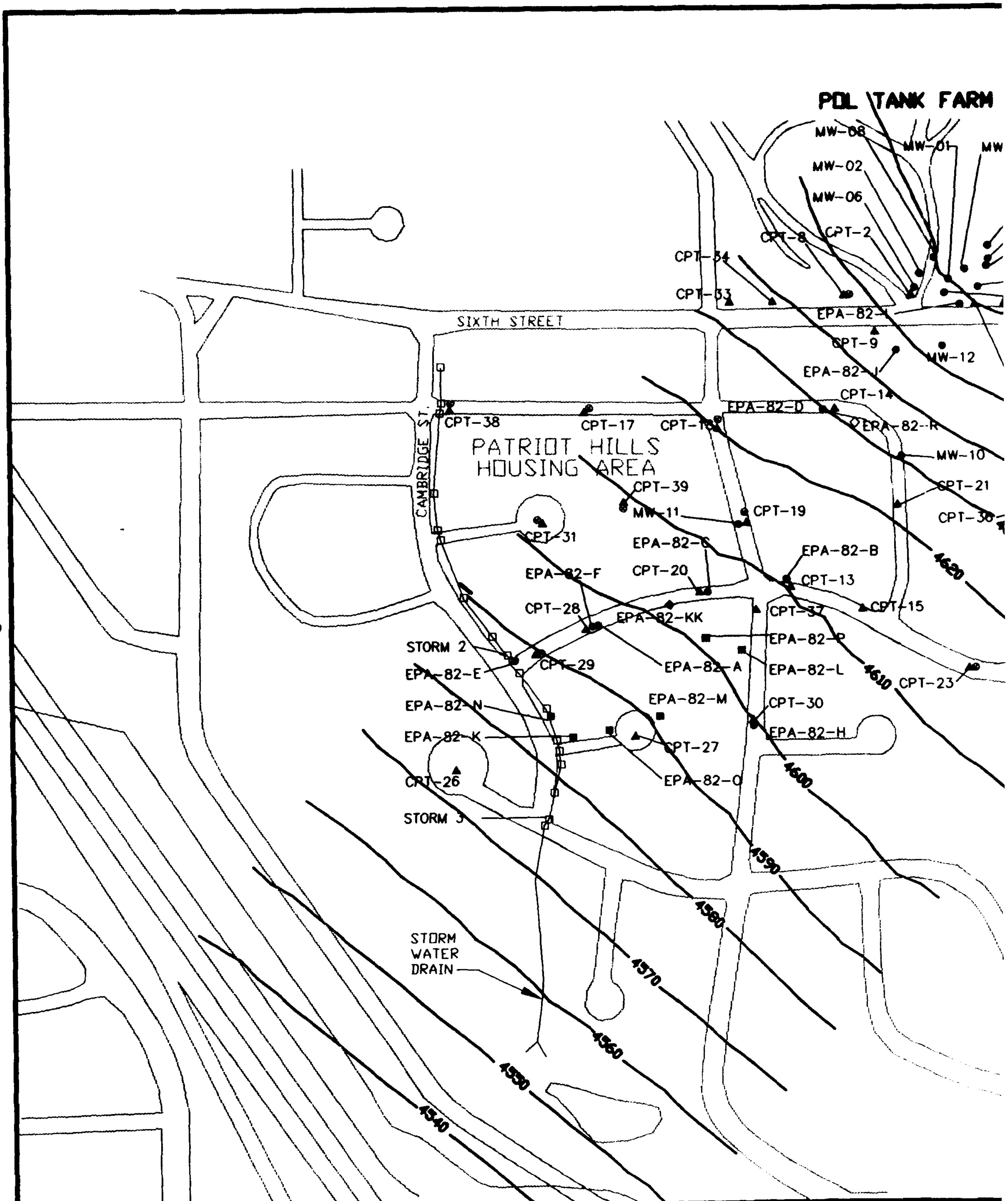
initial water levels at the constant-head cells and the transmissivity were varied to calibrate the water table surface. The model was calibrated under steady-state conditions.

Saturated thickness data from borehole logs, CPT reports, and water level measurements were used in conjunction with the average hydraulic conductivity as determined from slug tests (2.64×10^{-4} ft/s) to estimate transmissivity. To better match heads in the model to observed values, the transmissivities were progressively varied in rows and blocks until the potentiometric surface approximated the existing potentiometric surface within a 5-percent average variance. Thirteen monitoring wells and piezometer locations were used to compare between the measured and simulated heads of the final calibrations. The 13 selected locations were EPA-82-I, EPA-82-D, EPA-82-B, EPA-82-C, EPA-82-F, EPA-82-E, EPA-82-H, CPT-41, CPT-23, CPT-21, CPT-15, CPT-31, and MW-12. The root-mean-square (rms) error between observed and calibrated values at these points was 3.2 feet which corresponds to a calibration error of 2.5 percent (water levels dropped approximately 130 feet from northeast to southwest across the model grid). A plot of measured vs. calibrated heads shows a random distribution of calibrated heads and is shown in Appendix D. Deviation of points from a straight line should be randomly distributed in computer simulations (Anderson and Woessner, 1992).

In solving the ground water flow equation, Bioplume II establishes the water table surface and calculates an overall hydraulic balance that accounts for the numerical difference between flux into and out of the system. The hydraulic mass balance for the calibrated model was excellent, with 99.95 percent of the water flux into and out of the system being numerically accounted for. Figure 5.4 shows the calibrated water table.

5.5.2 BTEX Plume Calibration

Model input parameters affecting the distribution and concentration of the simulated BTEX plume were modified so that initial model results closely matched dissolved-phase total BTEX concentrations observed in August 1993, and model predictions approximated dissolved-phase total BTEX concentrations observed in July 1994. The extent of dissolved-phase BTEX contamination in 1993 and 1994 is described in Section 4.3.1. Because LNAPL is present at the site, it was necessary to include 20 injection cells to simulate partitioning of BTEX compounds from the LNAPL into the ground water. The location of the injection cells is shown on Figure 5.1. Chemical analysis of LNAPL from MW-10 indicate that the



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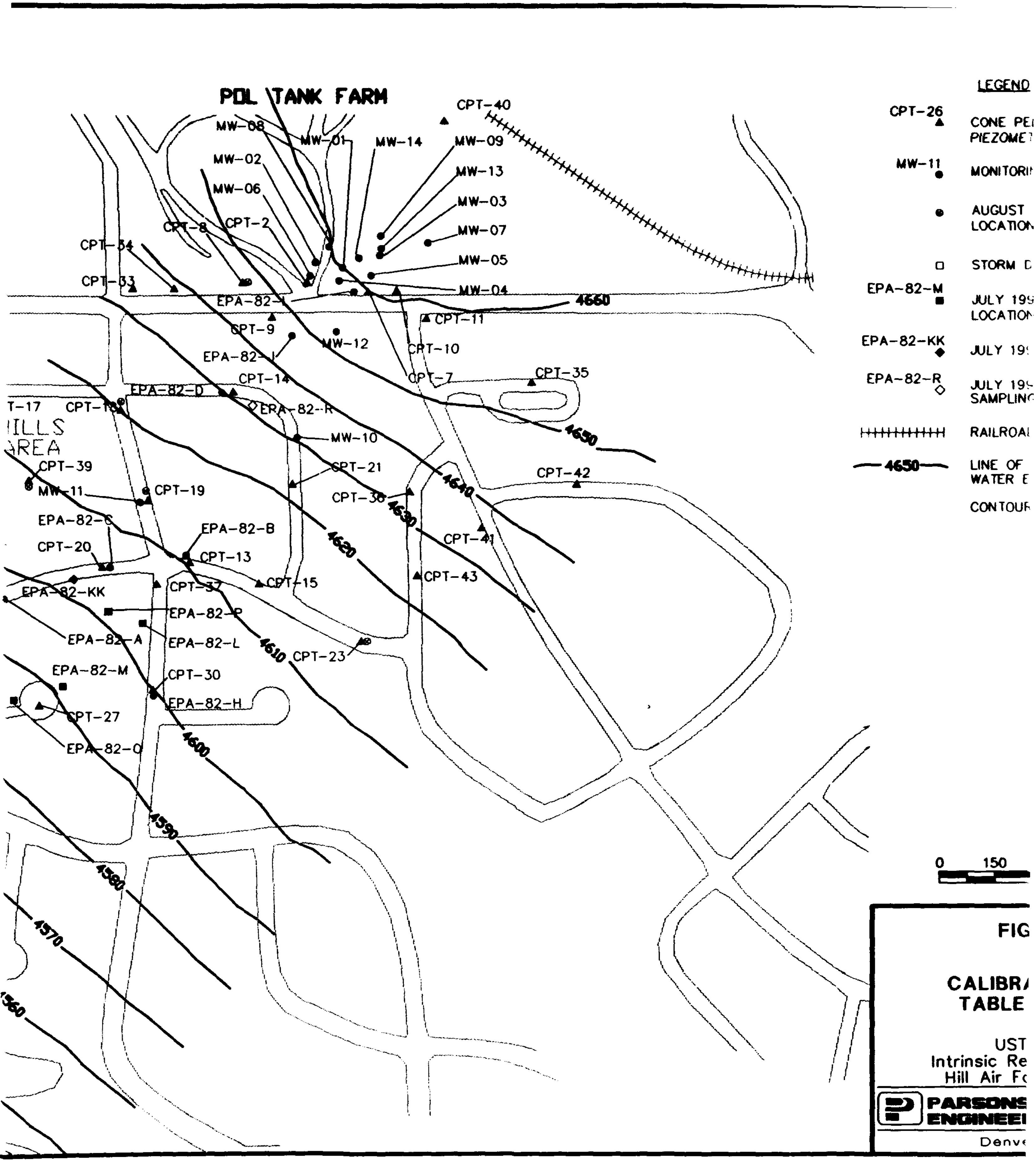
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EPA-82-J
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CPT-42
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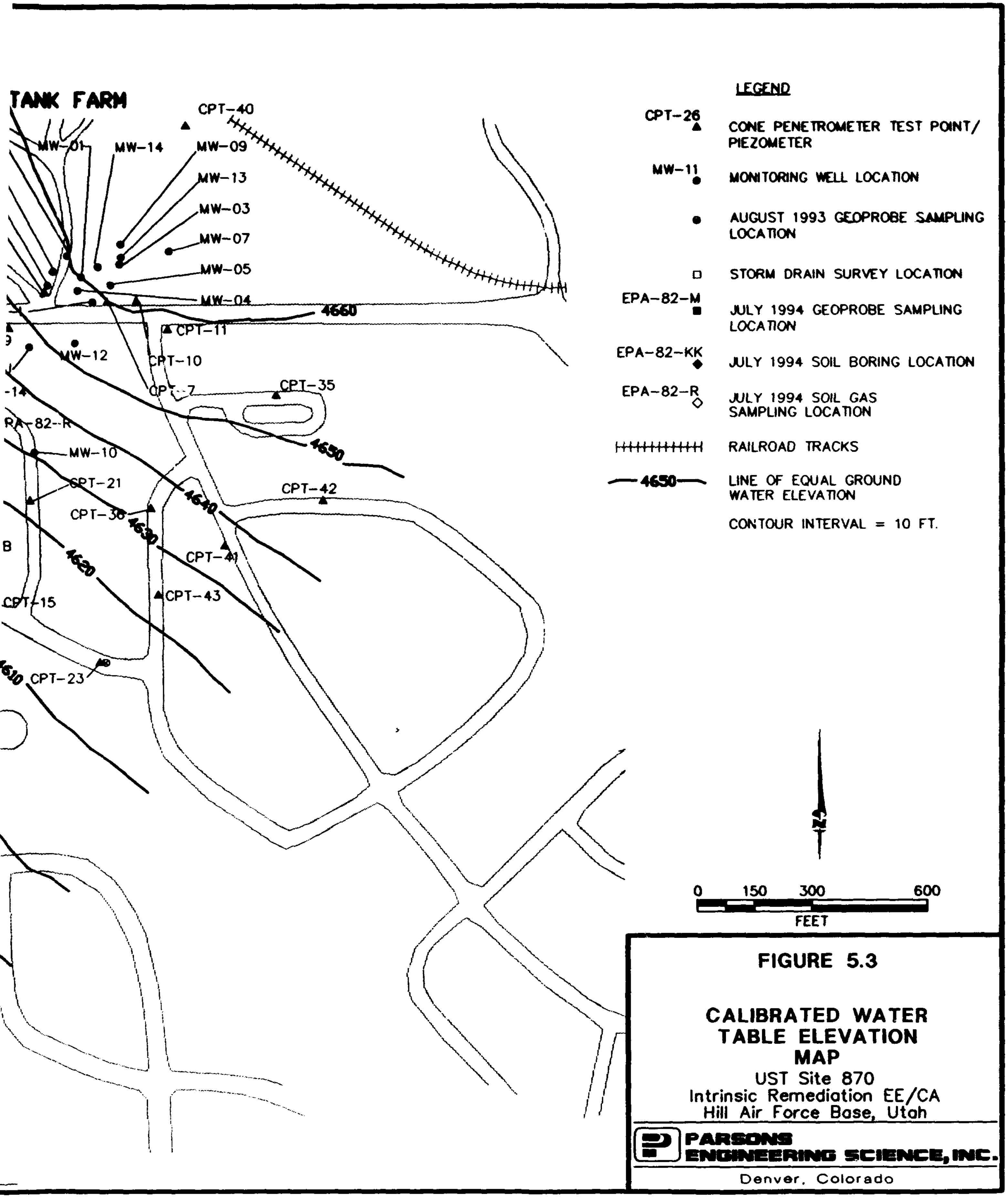

FIGURE 5.3

CALIBRATED WATER TABLE ELEVATION MAP

UST Site 870
Intrinsic Remediation EE/CA
Hill Air Force Base, Utah

PARSONS ENGINEERING SCIENCE, INC.

Denver, Colorado

LNAPL at the site is probably dominated by JP-4 jet fuel. LNAPL contamination is estimated to cover an area of approximately 225,000 square feet (Figure 4.1).

The injection rate of the cells was set at 5 cubic feet per day (cfd), a value low enough so that the ground water elevation calibration was not affected. Total BTEX injection concentrations were determined by varying the injection concentration in the various cells from 1 to 1,650 mg/L until the initial total BTEX plume generated by the model approximated the total BTEX plume observed in August 1993, and the model predictions approximated the change in dissolved-phase total BTEX concentrations that occurred between August 1993 and July 1994. Relatively high BTEX concentrations were injected in upgradient injection cells because of the influx of 34 mg/L of combined oxygen and ionic nitrate electron acceptor concentrations (5 mg/L DO and 10 mg/L nitrate as N) introduced at the upgradient constant-head cells. This high replenishment of available electron acceptors quickly degraded BTEX concentrations at the head of the plume as they flushed through the aquifer, which in turn required large injection concentrations of BTEX to maintain observed BTEX contours. By varying the injection well concentrations, the BTEX plume was calibrated reasonably well to the change in the total BTEX plume between August 1993 and July 1994 in terms of migration distance and BTEX concentrations directly under the LNAPL contamination.

5.6 SENSITIVITY ANALYSIS

The purpose of the sensitivity analysis is to determine the effect of varying model input parameters on model output. Based on the work of Rifai *et al.* (1988), the Bioplume II model is most sensitive to changes in the coefficient of reaeration, the coefficient of anaerobic decay, and the hydraulic conductivity of the media, and is less sensitive to changes in the retardation factor, porosity, and dispersivity. A first-order anaerobic decay coefficient was not used because nitrate was included in the original oxygen map to simulate anaerobic biodegradation at the site. Because the coefficient of anaerobic decay was set to zero, the sensitivity analysis was conducted by varying the hydraulic conductivity (and therefore transmissivity) and the coefficient of reaeration. Because of the potential for large dispersivity values at the site, a sensitivity analysis was also performed on this parameter.

To perform the sensitivity analyses, an individual run of the model was made with the same input as the calibrated model, except that one of the aforementioned parameters was varied. The models were run for 10 years so that the independent effect of each variable could be

assessed. As a result, six sensitivity runs of the calibrated model were made, with the following variations:

1) Hydraulic conductivity uniformly increased by a factor of 5;

2) Hydraulic conductivity uniformly decreased by a factor of 0.2;

3) Longitudinal dispersivity increased to 100;

4) Longitudinal dispersivity decreased to 5.34;

5) Reaeration coefficient increased to 0.03 day^{-1}; and

6) Reaeration coefficient decreased to 0.0003 day^{-1}.

The results of the sensitivity analyses are shown graphically in Figures 5.5, 5.6, and 5.7. These figures display the modeled BTEX concentrations versus distance along the centerline of the plume. This manner of displaying data is useful because the plume is narrow and maintains a constant plume migration direction parallel to the model grid. Furthermore, the figures allow easy visualization of the changes in BTEX concentration caused by varying model input parameters.

Uniformly increasing the hydraulic conductivity in the model by half an order of magnitude (model H1) drastically increased the migration rate and biodegradation rate of the plume (Figure 5.5). Plume migration and influx of fresh electron acceptors was so rapid that no appearance of BTEX concentrations was predicted by the model. This was caused by an abnormally high influx of electron acceptors in the highly conductive aquifer that immediately biodegraded existing and injected BTEX concentrations. In contrast, decreasing the hydraulic conductivity by a half-order of magnitude slowed plume migration, which in turn caused an increase in measured BTEX levels in the source area. Increased BTEX concentrations in the source area are caused by a reduction in the amount of electron acceptors being brought into contact with the plume from upgradient locations.

The ef ect of varying the coefficient of reaeration is shown in Figure 5.6. Decreases in total BTEX mass in ground water caused by increasing the reaeration coefficient from 0.003 day^{-1} to 0.03day^{-1} was significant, and complete biodegradation of all existing and injected

FIGURE 5.5
PLOT OF TOTAL BTEX VS DISTANCE ALONG PLUME CENTERLINE WITH VARYING HYDRAULIC CONDUCTIVITY
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

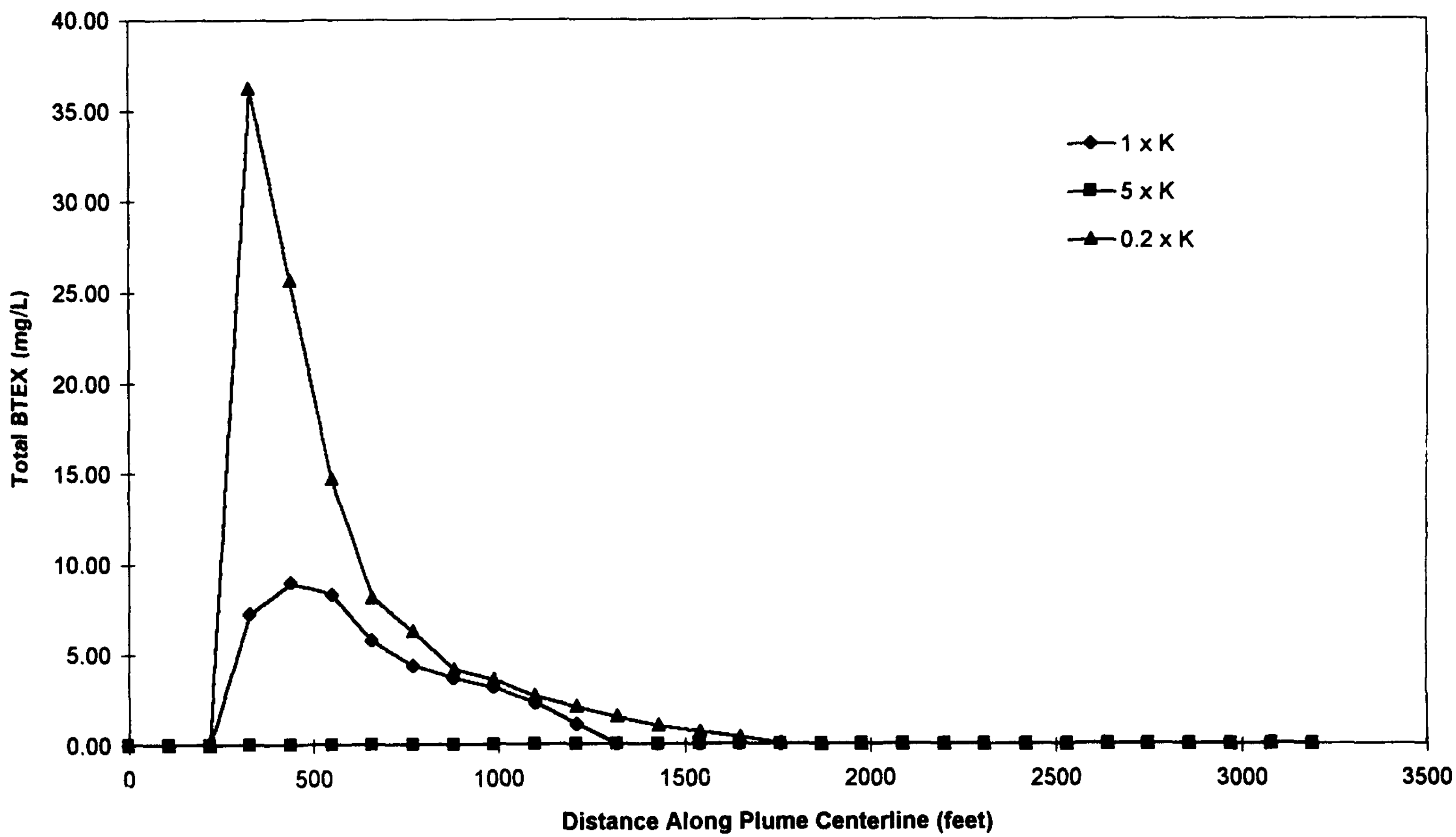

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FIGURE 5.6
PLOT OF TOTAL BTEX VS DISTANCE ALONG PLUME CENTERLINE WITH VARYING COEFFICIENT OF REAERATION
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

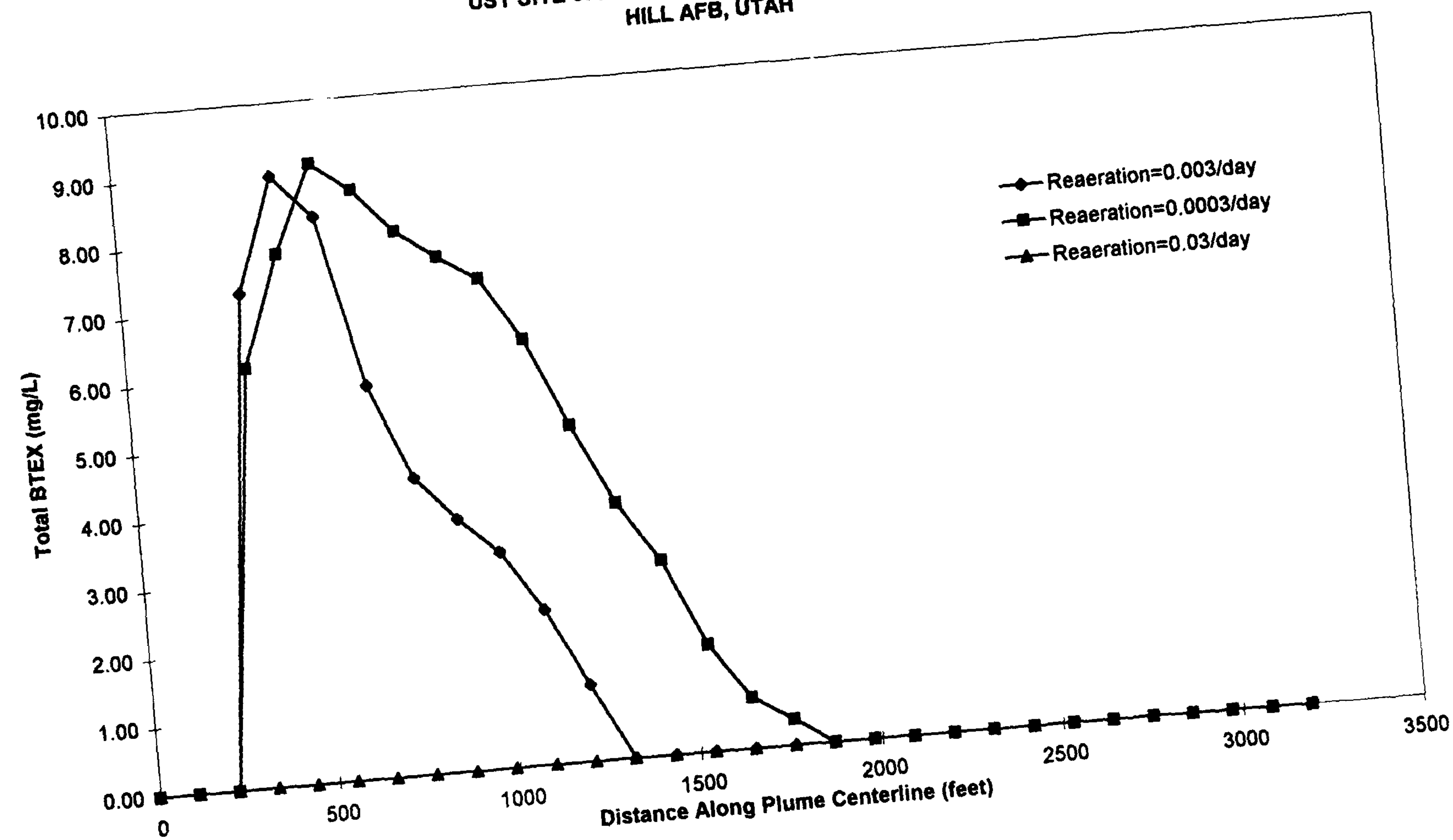

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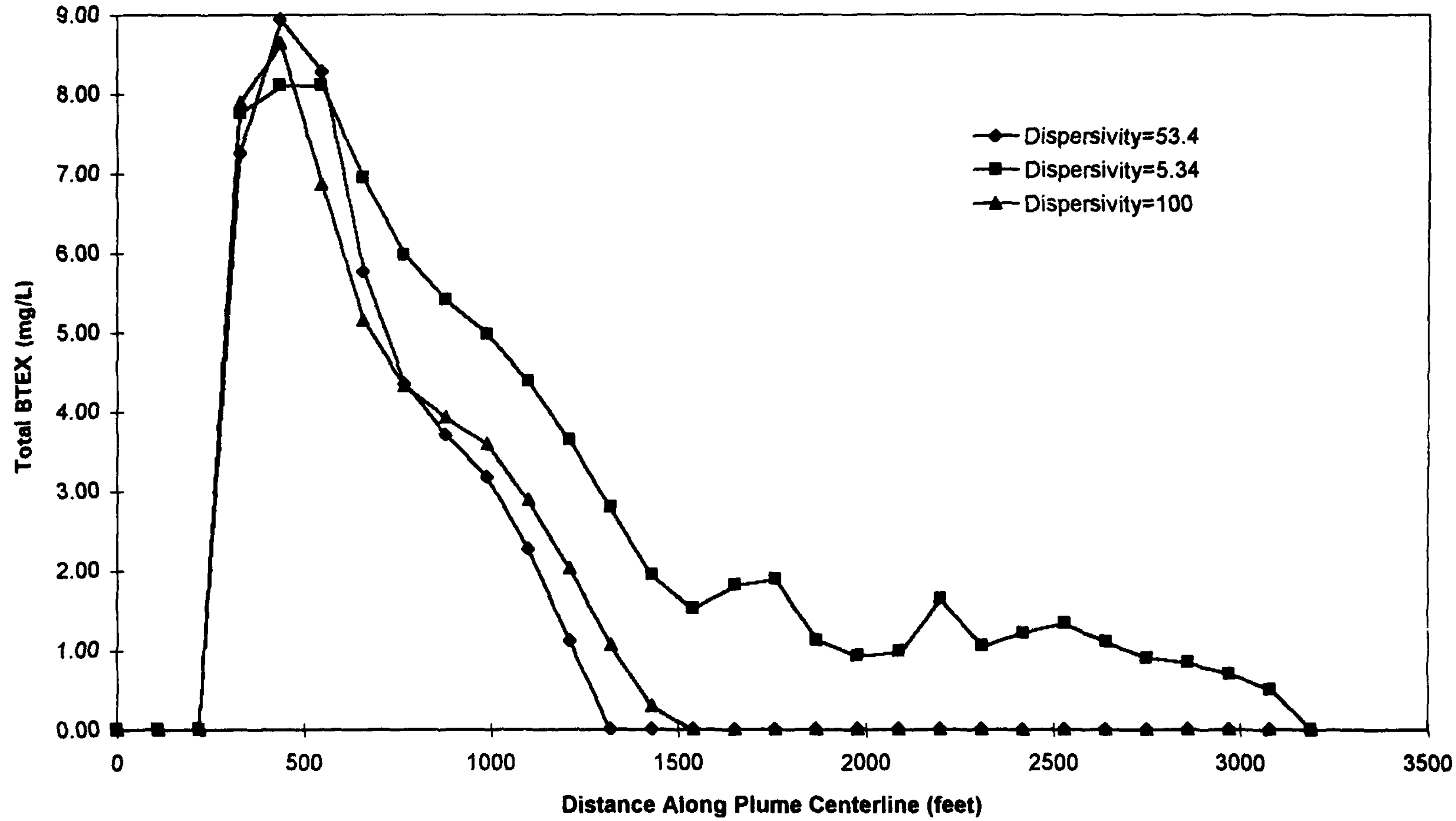
FIGURE 5.7
PLOT OF TOTAL BTEX VS DISTANCE ALONG
PLUME CENTERLINE WITH VARYING DISPERSIVITY
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH



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BTEX occurred instantaneously. By reducing the reaeration coefficient by an order of magnitude, a more modest change in the shape of the plume occurred. The downgradient end of the plume extended approximately 500 feet past its observed location.

Figure 5.7 illustrates the effects of varying longitudinal dispersivity. Decreasing the dispersivity resulted in a larger migration distance for the BTEX plume. This occurs because lowering the dispersivity keeps the plume from spreading out into more electron acceptor-rich portions of the aquifer. Increasing the dispersivity resulted in faster dilution of BTEX in the source area; however, the migration distance of the BTEX was only slightly altered by increasing the dispersivity.

The results of the sensitivity analysis suggest that the calibrated model used for this report is reasonable. Increasing the coefficient of reaeration or the hydraulic conductivity greatly affects the predicted BTEX concentration and distribution. Lowering the values of these variables causes an abnormal lengthening of the plume to beyond reasonable distances based on observations made at the site between August 1993 and July 1994. The calibrated model appears to reasonably simulate the observed BTEX plume.

5.7 MODEL RESULTS

The Bioplume II® model was run under steady-state conditions with no LNAPL removal, 5-percent annual LNAPL removal, and 15-percent annual LNAPL removal until the plume reached steady-state equilibrium (no LNAPL removal) or until the plume disappeared (LNAPL removal scenarios). The model with no LNAPL removal best simulated the current site conditions. As previously mentioned, LNAPL contamination at the site is extensive. LNAPL reduction through source removal, in concert with natural attenuation can significantly reduce the longevity of the BTEX contamination at the site.

Although the results of each model run varied depending on the amount of LNAPL dissolution over time, two trends were consistently observed, including:

1) The plume shape in each simulation is elongated because of the rapid advective transport of BTEX contamination and rapid biodegradation of BTEX at the plume periphery. This is consistent with what was observed between August 1993 and July 1994 (Figures 4.4 and 4.5);

2) A BTEX partitioning threshold develops in the two models that simulate a reduction in the LNAPL source term. In both models the hydrocarbon plume disappears when the BTEX injection concentration is reduced to approximately 55 percent of its original value. This occurs because replenished electron acceptor concentrations greatly exceed the BTEX contamination introduced into the aquifer by the prescribed biodegradation ratio of DO and DO-equivalent nitrate to BTEX of 3.1:1

The following sections describe the results of each model scenario.

5.7.1 No Source Removal (Model Hill-A)

Model Hill-A simulated the migration and biodegradation of the BTEX plume assuming no LNAPL weathering or removal. Approximately 3,900 gm (39,000 mg or 390,000 μg) of dissolved-phase BTEX contamination existed at the start of modeling (T=0, based on data from August 1993). This estimate was calculated by Bioplume II, which summed all dissolved BTEX contamination over the Hill AFB model domain at time zero. Contaminant migration was rapid because of the high hydraulic conductivity and steep hydraulic gradient present at the site. The total BTEX plume thins in shape and stretches just past Cambridge Street after 1 year (Figure 5.8). The Bioplume II model predicted that the plume would reach steady-state equilibrium within 4 years. Figures 5.8 and 5.9 show the predicted total BTEX concentrations at years 1 and 10. The plume migrates in the expected southwest direction, and by 1 year, levels of greater than 1 μg/L of dissolved-phase BTEX are predicted to reach the vicinity of Cambridge Street in the Patriot Hills Housing complex. However, the stabilized plume (> 4 years) has slightly receded and only extends as far as the intersection of Cambridge Street and Adams Circle. The stabilized plume predicted by the model closely resembles the plume observed at the site in July 1994. Differences in modeled and actual plume shape are caused by physical, chemical, and biological variations within the shallow saturated zone that result from natural aquifer heterogeneity.

5.7.2 Five-Percent Annual Source Removal (Model Hill-B)

Model Hill-B simulated the migration and biodegradation of the BTEX plume assuming a 5-percent annual reduction in source BTEX concentrations caused by natural weathering processes and limited source removal by LNAPL skimming and bioventing. Model Hill-B is

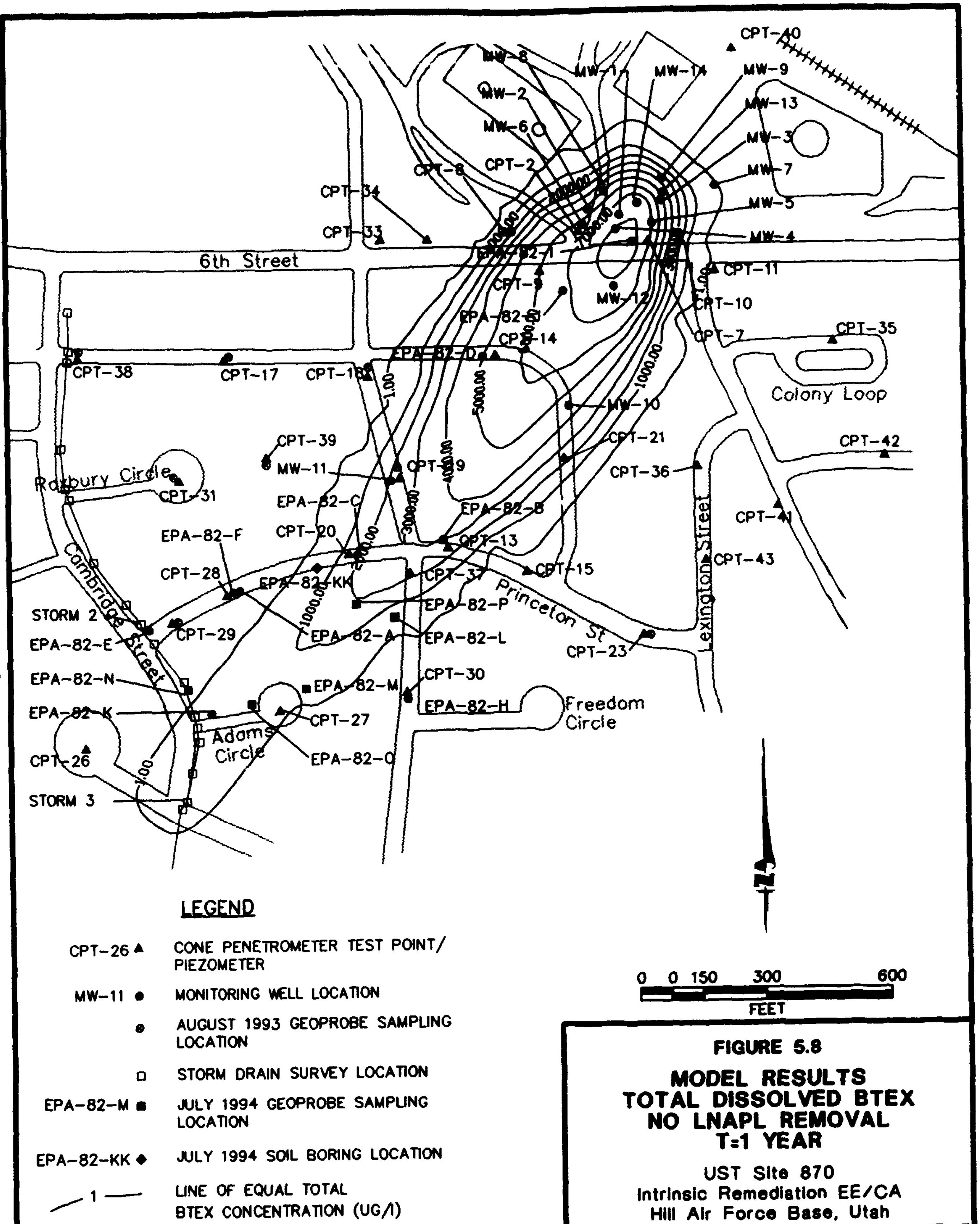

FIGURE 5.8

MODEL RESULTS TOTAL DISSOLVED BTEX NO LNAPL REMOVAL T=1 YEAR

UST Site 870
Intrinsic Remediation EE/CA
Hill Air Force Base, Utah

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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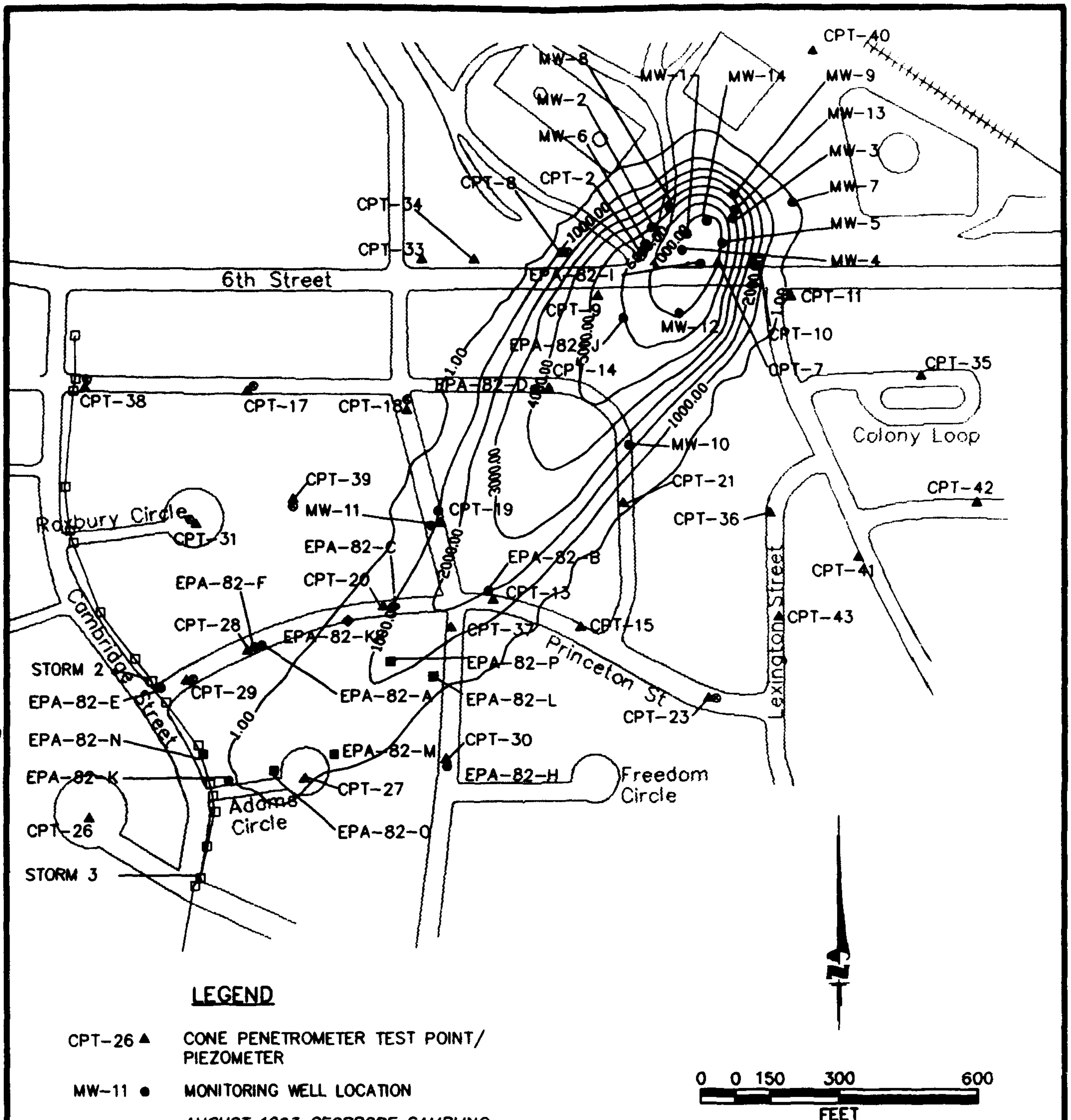

LEGEND

CPT-26 ▲	CONE PENETROMETER TEST POINT/ PIEZOMETER
MW-11 ●	MONITORING WELL LOCATION
●	AUGUST 1993 GEOPROBE SAMPLING LOCATION
□	STORM DRAIN SURVEY LOCATION
EPA-82-M ■	JULY 1994 GEOPROBE SAMPLING LOCATION
EPA-82-KK ◆	JULY 1994 SOIL BORING LOCATION
— 1 —	LINE OF EQUAL TOTAL BTEX CONCENTRATION (UG/l)

FIGURE 5.9

MODEL RESULTS TOTAL DISSOLVED BTEX NO LNAPL REMOVAL T=10 YEARS

UST Site 870
Intrinsic Remediation EE/CA
Hill Air Force Base, Utah

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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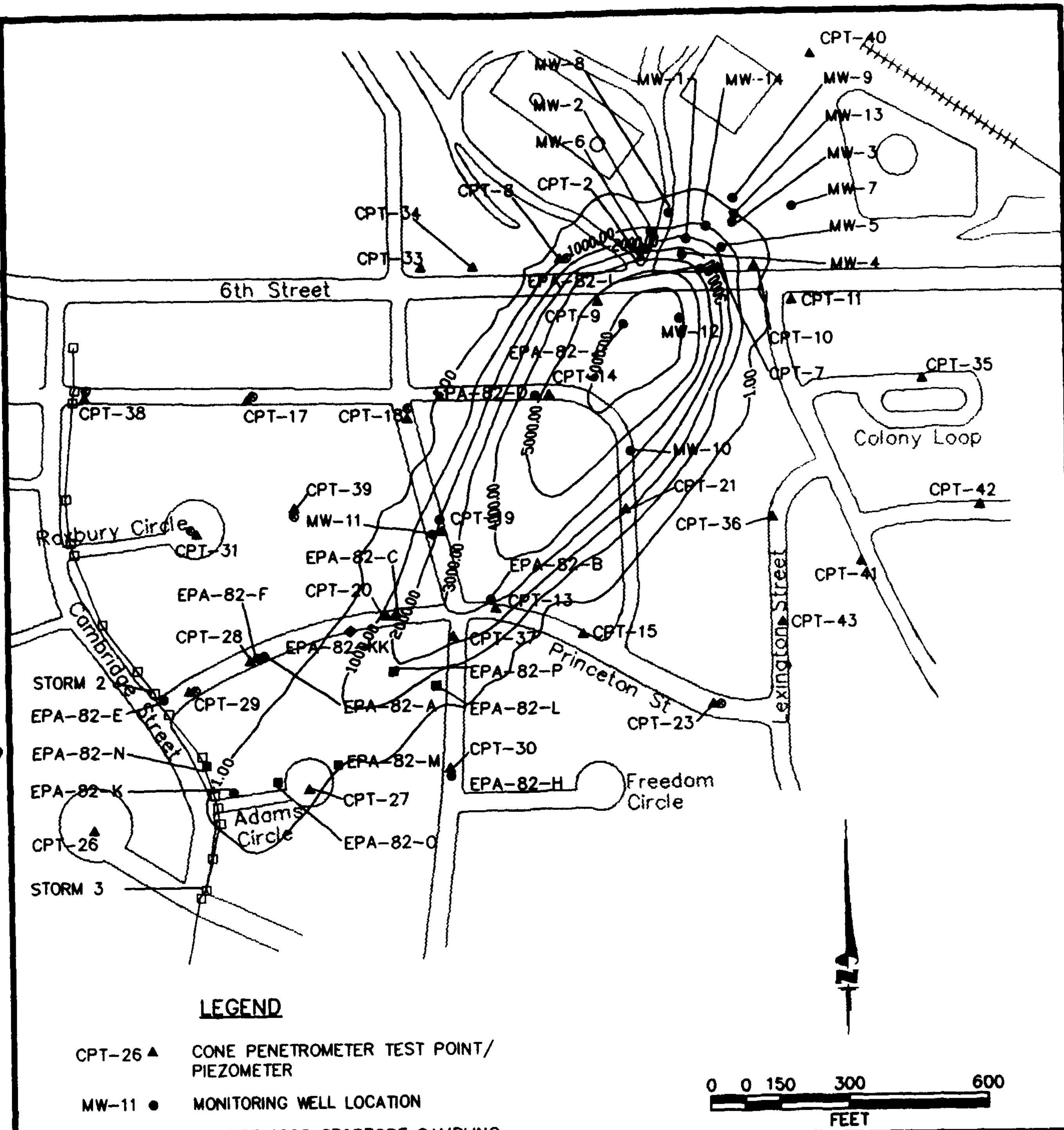
identical to model Hill-A with the exception of the 5-percent annual source removal term. Figures 5.10, 5.11, and 5.12 show the results of this model. The simulation time of the model was 25 years because 20 years were required before the LNAPL was theoretically reduced to 0 percent of its original partitioning strength. Despite the lengthy estimated period required to remove all the LNAPL contamination, BTEX disappeared in model simulations long before free-phase partitioning of BTEX from the LNAPL into the ground water ceased. The initial extent and concentration of BTEX contamination in years 1 and 2 were nearly identical to those predicted in model Hill-A. However, after 4 years the plume had noticeably receded at the periphery and the internal concentrations of BTEX were reduced by as much as 2 mg/L (2,000 μg/L). By year 7, the plume was approximately 10 percent of its original area, and the maximum concentration of BTEX was predicted to be only 300 μg/L in the source area. The reach of contamination at this point extends roughly 100 feet northwest of the intersection at Princeton Street and Liberty Road. Although BTEX partitioning was simulated for the first 19 years of the pumping period, dissolved-phase BTEX contamination was estimated to be completely degraded after 7 years. This situation is caused by the influx of electron acceptors by upgradient replenishment and reaeration that exceed the levels required to biodegraded the BTEX contamination injected into the 20 injection cells of the model grid.

5.7.3 Fifteen-Percent Annual Source Removal (Model Hill-C)

Model Hill-C simulated the migration and biodegradation of the BTEX plume assuming a 15-percent annual reduction in source BTEX concentrations caused by natural weathering processes and more active source removal by expanded LNAPL pumping and expanded bioventing. Model Hill-C is identical to model Hill-A with the exception of the 15-percent annual source removal term. Figures 5.13 and 5.14 show the results of this model for 1 and 3 years after the implementation of a 15-percent annual source removal technology. The initial 1 year prediction of plume migration suggests that the plume would extend as far as Cambridge Street at concentrations of 1 μg/L. By year 3 (Figure 5.14), the BTEX plume had undergone significant loss, including a complete reduction of BTEX contamination in the source area. By year 4, the plume had entirely disappeared. This complete plume disappearance at year 4 was caused by the injection loading rates of modeled BTEX to be reduced to 55 percent of the original loading rate, which was below the biodegradation capacity of the upgradient, influent electron acceptors and aquifer reaeration.



LEGEND

CPT-26 ▲	CONE PENETROMETER TEST POINT/ PIEZOMETER
MW-11 ●	MONITORING WELL LOCATION
⊛	AUGUST 1993 GEOPROBE SAMPLING LOCATION
□	STORM DRAIN SURVEY LOCATION
EPA-82-M ■	JULY 1994 GEOPROBE SAMPLING LOCATION
EPA-82-KK ◆	JULY 1994 SOIL BORING LOCATION
—1—	LINE OF EQUAL TOTAL BTEX CONCENTRATION (UG/l)

FIGURE 5.10

MODEL RESULTS
TOTAL DISSOLVED BTEX
5% ANNUAL LNAPL REMOVAL
T=1 YEAR

UST Site 870
Intrinsic Remediation EE/CA
Hill Air Force Base, Utah

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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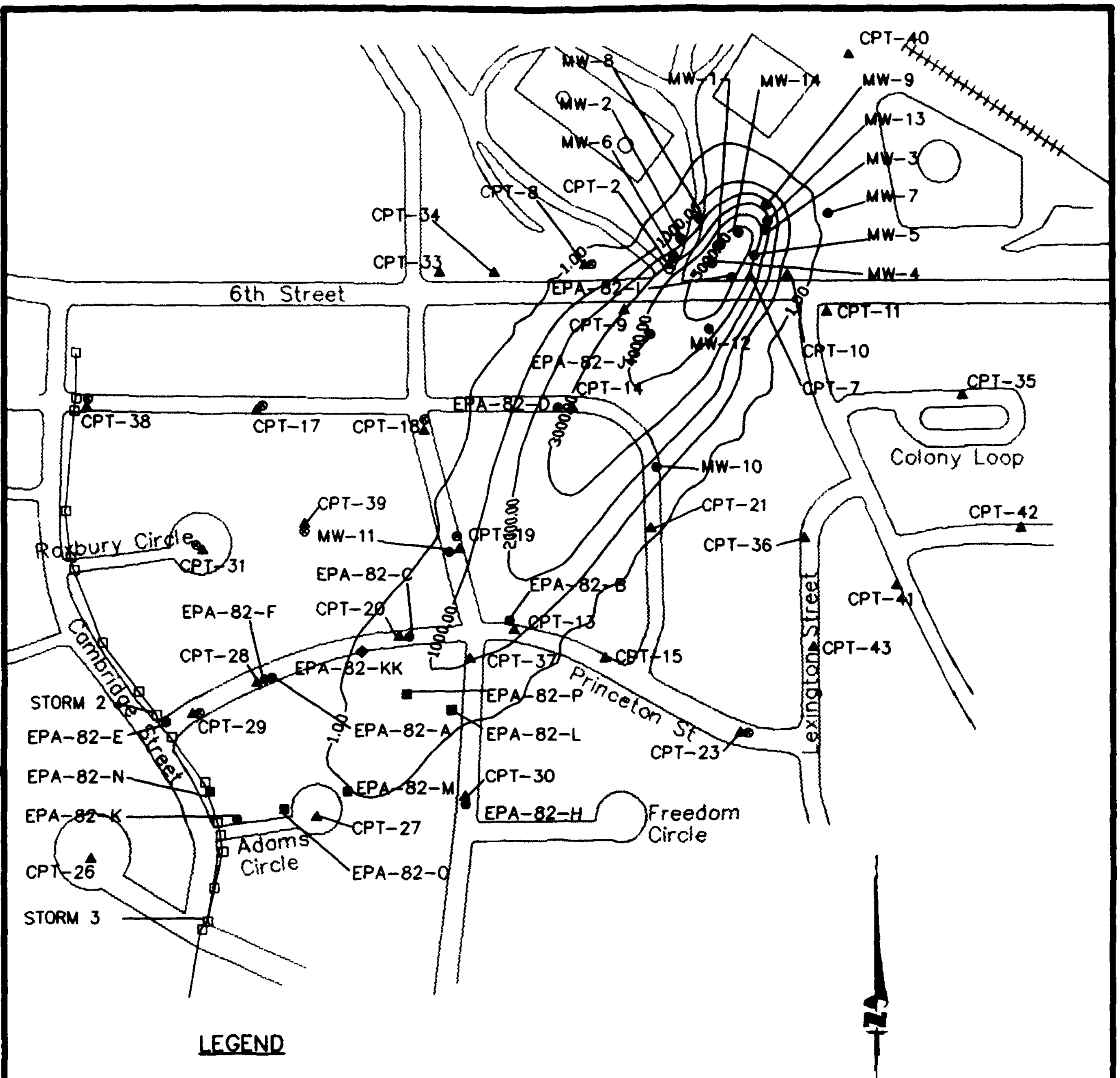

LEGEND

CPT-26 ▲	CONE PENETROMETER TEST POINT/ PIEZOMETER
MW-11 ●	MONITORING WELL LOCATION
⊛	AUGUST 1993 GEOPROBE SAMPLING LOCATION
□	STORM DRAIN SURVEY LOCATION
EPA-82-M ■	JULY 1994 GEOPROBE SAMPLING LOCATION
EPA-82-KK ◆	JULY 1994 SOIL BORING LOCATION
— 1 —	LINE OF EQUAL TOTAL BTEX CONCENTRATION (μg/L)

CONTOUR INTERVAL = 1,000 μg/L

FIGURE 5.11

MODEL RESULTS
TOTAL DISSOLVED BTEX
5% ANNUAL LNAPL REMOVAL
T=4 YEARS

UST Site 870
Intrinsic Remediation EE/CA
Hill Air Force Base, Utah

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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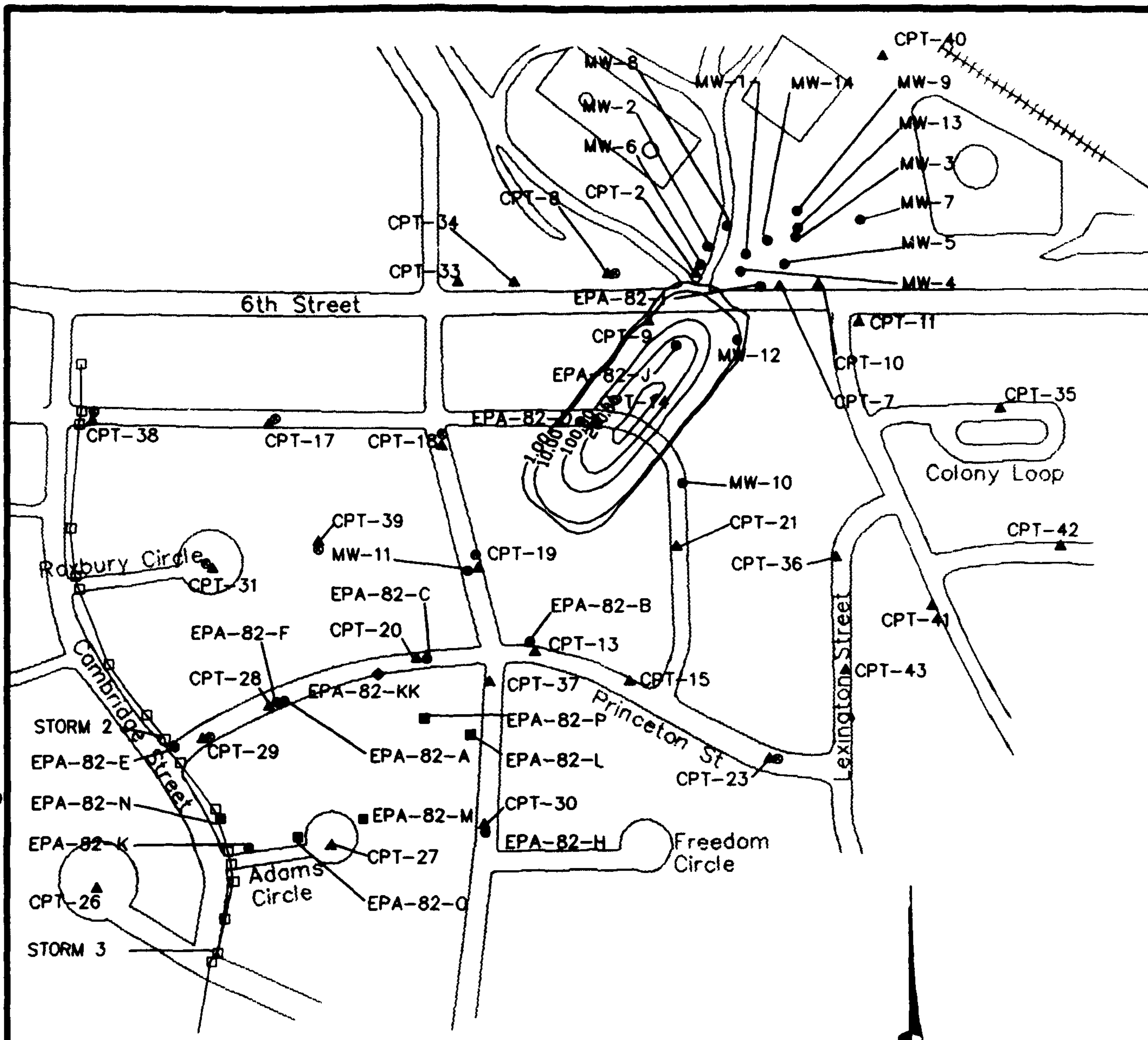


LEGEND

CPT-26 ▲	CONE PENETROMETER TEST POINT/ PIEZOMETER
MW-11 ●	MONITORING WELL LOCATION
⊕	AUGUST 1993 GEOPROBE SAMPLING LOCATION
□	STORM DRAIN SURVEY LOCATION
EPA-82-M ■	JULY 1994 GEOPROBE SAMPLING LOCATION
EPA-82-KK ◆	JULY 1994 SOIL BORING LOCATION
— 1 —	LINE OF EQUAL TOTAL BTEX CONCENTRATION ($\mu g/L$)

CONTOUR INTERVAL = 100 $\mu g/L$

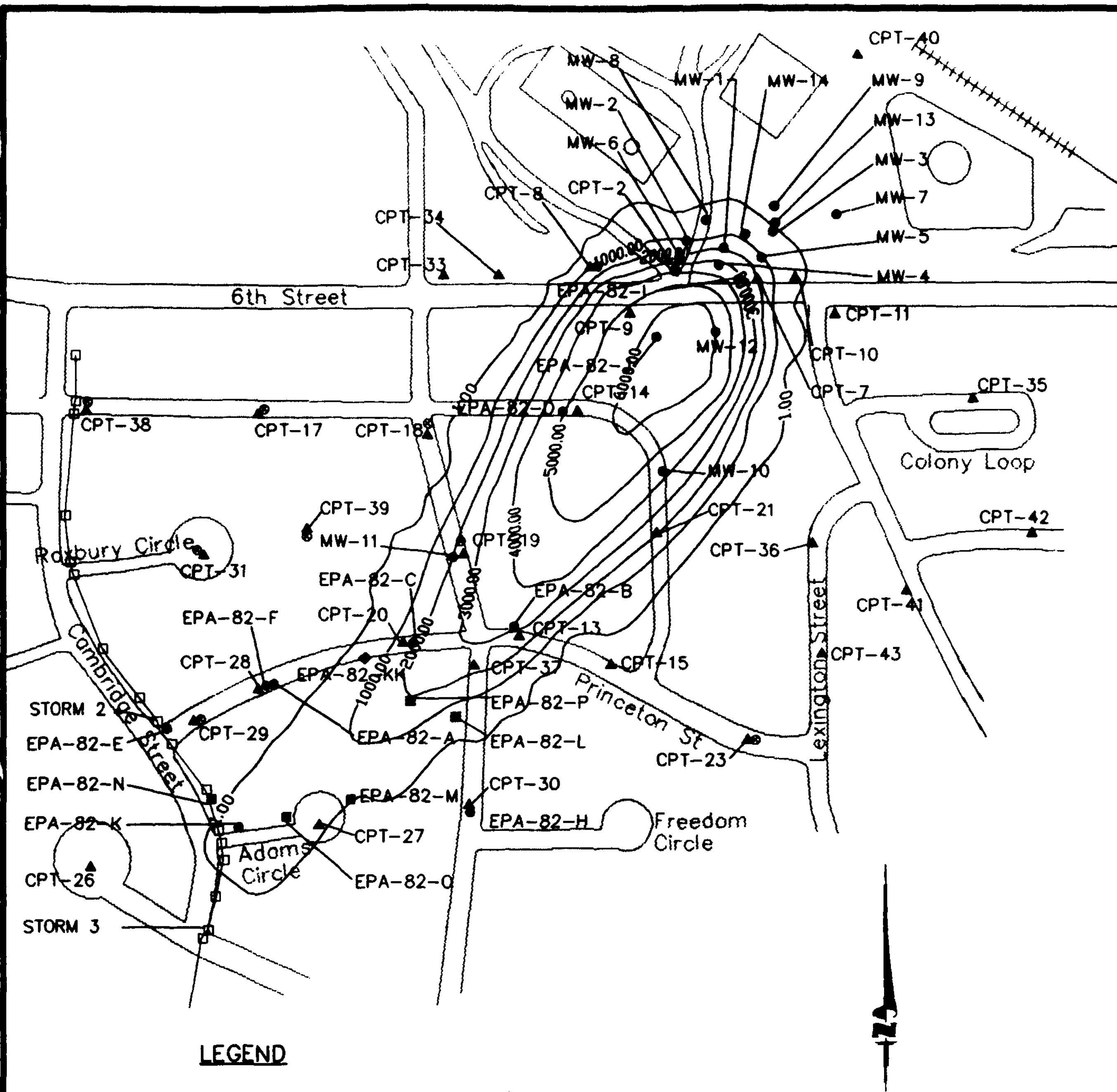
0 0 150 300 600
FEET

FIGURE 5.12

MODEL RESULTS
TOTAL DISSOLVED BTEX
5% ANNUAL LNAPL REMOVAL
T=7 YEARS

UST Site 870
Intrinsic Remediation EE/CA
Hill Air Force Base, Utah

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado



LEGEND

CPT-26 ▲	CONE PENETROMETER TEST POINT/ PIEZOMETER
MW-11 ●	MONITORING WELL LOCATION
⊗	AUGUST 1993 GEOPROBE SAMPLING LOCATION
◻	STORM DRAIN SURVEY LOCATION
EPA-82-M ■	JULY 1994 GEOPROBE SAMPLING LOCATION
EPA-82-KK ◆	JULY 1994 SOIL BORING LOCATION
— 1 —	LINE OF EQUAL TOTAL BTEX CONCENTRATION ($\mu g/L$)

CONTOUR INTERVAL = 1,000 $\mu g/L$

0 0 150 300 600
FEET

FIGURE 5.13

MODEL RESULTS TOTAL DISSOLVED BTEX 15% ANNUAL LNAPL REMOVAL T=1 YEAR

UST Site 870
Intrinsic Remediation EE/CA
Hill Air Force Base, Utah

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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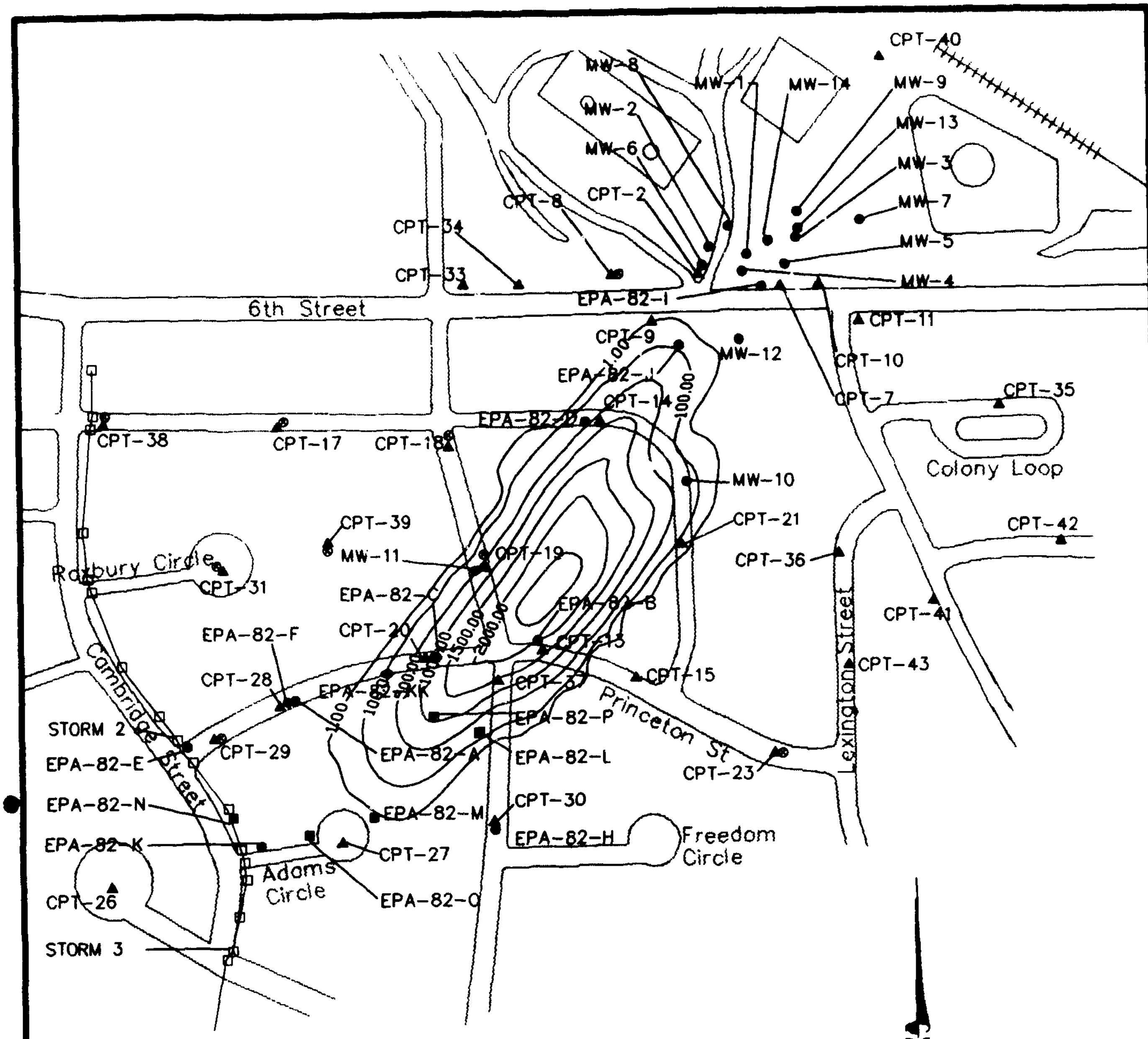
LAYER: HCBTEX1



LEGEND

CPT-26 ▲	CONE PENETROMETER TEST POINT/ PIEZOMETER
MW-11 ●	MONITORING WELL LOCATION
⊗	AUGUST 1993 GEOPROBE SAMPLING LOCATION
□	STORM DRAIN SURVEY LOCATION
EPA-82-M ■	JULY 1994 GEOPROBE SAMPLING LOCATION
EPA-82-KK ◆	JULY 1994 SOIL BORING LOCATION
— 1 —	LINE OF EQUAL TOTAL BTEX CONCENTRATION (μg/L)

CONTOUR INTERVAL = 500 μg/L

0 0 150 300 600
FEET

FIGURE 5.14

MODEL RESULTS
TOTAL DISSOLVED BTEX
15% ANNUAL LNAPL REMOVAL
T=3 YEARS

UST Site 870
Intrinsic Remediation EE/CA
Hill Air Force Base, Utah

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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5.9 CONCLUSIONS

Contaminant fate and transport at UST Site 870 was simulated using the finite-difference ground water model Bioplume II. Model results suggest that BTEX contamination may possibly migrate to Cambridge Street and the stormwater sewer running parallel to this street in all models. However, model simulations conducted during this project are extremely conservative for several reasons, including:

1) Aerobic respiration, denitrification, iron reduction, sulfanogenesis, and methanogenesis are all occurring at this site; however, only DO and nitrate are considered as electron acceptors during model simulations;

2) The stoichiometry used to determine the ratio between DO and nitrate-equivalent DO assumed that no microbial cell mass was produced during the reaction. As discussed in Section 4.3.2.1, this approach may be too conservative by a factor of three.

3) The highest DO concentration observed at the site was 6.3 mg/L. The highest DO concentration assumed during model simulations was 5.0 mg/L. In addition, the highest observed nitrate concentration observed at the site was 17 mg/L. The highest nitrate concentration assumed during model simulations was 10 mg/L. This nitrate concentration came only from upgradient, constant head cells; the majority of the area outside the plume was assumed to have nitrate concentrations of only 5 mg/L.

4) The lowest coefficient of retardation for benzene (1.29) was used for model simulations. Coefficient of retardation values for the other BTEX compounds range from 1.7 to 3.35. The use of the low coefficient of retardation tends to increase the distance traveled by the simulated BTEX plume, but provides a more accurate estimate of benzene transport.

The results of the Bioplume II modeling effort were used to help develop and compare ground water remedial options. This comparative analysis of remedial options is presented in Section 6.

SECTION 6

COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

This section presents the development and comparative analysis of three ground water remedial alternatives for UST Site 870 at Hill AFB. The intent of this evaluation is to determine if intrinsic remediation is an appropriate and cost-effective remedial technology to consider when developing final remedial strategies for UST Site 870, especially when combined with other innovative and conventional remedial technologies.

Section 6.1 presents the evaluation criteria to be used to evaluate ground water remedial alternatives. Section 6.2 discusses the development of remedial alternatives to be considered as part of this demonstration project. Section 6.3 provides a brief description of each of these remedial alternatives. Section 6.4 provides a more detailed analysis of the remedial alternatives using the defined remedial alternative evaluation criteria. The results of this evaluation process are summarized in Section 6.5.

6.1 REMEDIAL ALTERNATIVE EVALUATION CRITERIA

The evaluation criteria used to identify the most appropriate remedial alternative for shallow ground water contamination at UST Site 870 were adapted from those recommended by the USEPA for selecting remedies for Superfund sites (OSWER Directive 9902.3). These criteria included (1) long-term effectiveness and permanence, (2) technical and administrative implementability, and (3) relative cost. The following sections briefly describe the scope and purpose of each evaluation criterion. This report does not include a complete discussion of applicable or relevant and appropriate requirements (ARARs) for the site. Rather, this report focuses on the potential use of intrinsic remediation and source reduction technologies to reduce BTEX concentrations within the shallow ground water to levels that pose an acceptable risk to human health or the environment.

6.1.1 Long-Term Effectiveness and Permanence

Each remedial technology or remedial alternative (which can be a combination of remedial technologies such as intrinsic remediation and institutional controls) is analyzed to determine

how effectively it will minimize ground water plume expansion so that ground water quality standards can be achieved at a downgradient POC. The expected technical effectiveness based on case histories from Hill AFB sites and other sites with similar conditions is also evaluated. The ability to minimize potential impacts to surrounding facilities and operations is considered. The ability of each remedial alternative to protect both current and potential future receptors from potential risks associated with site-related contamination in shallow ground water is qualitatively assessed by conservatively estimating if a potential exposure pathway involving ground water could be completed, either now or in the future. This evaluation criterion also included permanence and the ability to reduce contaminant mass, toxicity, and volume. Time to implem[illegible]d time until protection is achieved is described. Long-term reliability for providing continued protection, including an assessment of potential for failure of the technology and the potential threats resulting from such a failure, is also presented.

6.1.2 Implementability

The technical implementation of each remedial technology or remedial alternative was evaluated in terms of technical feasibility and availability. Potential shortcomings and difficulties in construction, operations, and monitoring are presented and weighed against perceived benefits. Requirements for any post-implementation site control, such as long-term monitoring and land use restrictions, are described. Details on administrative feasibility in terms of the likelihood of public acceptance and the ability to obtain necessary approvals is discussed.

6.1.3 Cost

The total cost (present worth) of each remedial alternative was estimated for relative comparison. An estimate of capital costs, and operating and post-implementation costs for site monitoring and land use controls is included. An annual inflation factor of 5 percent was applied in calculating the present value of operation, maintenance, and monitoring costs.

6.2 FACTORS INFLUENCING ALTERNATIVES DEVELOPMENT

Several factors were considered during the identification and screening of remedial technologies for addressing shallow ground water contamination at UST Site 870. Factors considered included the objectives of the natural attenuation demonstration program; contaminant, ground water and soil properties; present and future land use; and potential

exposure pathways. This section briefly describes each of these factors and how they were used to narrow the list of potentially applicable remedial technologies to the final remedial alternatives considered for UST Site 870.

6.2.1 Program Objectives

The intent of the Natural Attenuation (Intrinsic Remediation) Demonstration Program sponsored by AFCEE is to develop a systematic process for scientifically investigating and documenting naturally occurring subsurface attenuation processes that can be factored into overall site remediation plans. The objective of this program and the specific UST Site 870 study is to provide solid evidence of intrinsic remediation of dissolved-phase fuel hydrocarbon so that this information can be used to develop an effective ground water remediation strategy. A secondary goal of this multi-site initiative is to provide a series of regional case studies which demonstrate that natural processes of contaminant degradation can often reduce contaminant concentrations in ground water to below acceptable cleanup standards before completion of potential exposure pathways.

Because the objective of this program is to study natural processes in the saturated zone rather than in all contaminated media (e.g., unsaturated soil, or soil gas), technologies have been evaluated based on their potential impact on shallow ground water and phreatic soils. Technologies that can reduce vadose zone contamination and partitioning of contaminants into ground water have also been evaluated. Many of the source removal technologies evaluated in this section will also reduce soil and soil gas contamination, but it is important to emphasize that the remedial alternatives developed in this document are not intended to remediate all contaminated media. Additional program objectives set forth by AFCEE include cost-effectiveness and minimization of waste. Technologies that may meet these criteria include institutional controls, soil vapor extraction, bioventing, mobile LNAPL removal, biosparging, ground water extraction and treatment (air stripping), and intrinsic remediation. Soil excavation, slurry walls, sheet piling, carbon adsorption, *ex situ* biological or chemical treatment, and onsite/offsite disposal are not attractive technology candidates for this site.

6.2.2 Contaminant Properties

The site-related contaminants targeted as part of this demonstration at UST Site 870 are the BTEX compounds. The source of this contamination is weathered JP-4 jet fuel present as residual LNAPL in capillary fringe soil and as mobile LNAPL floating on the ground water surface within the source area of UST Site 870. The physiochemical characteristics of both

JP-4 and the individual BTEX compounds will greatly influence the effectiveness and selection of a remedial technology.

Petroleum hydrocarbon mixtures, such as JP-4 jet fuel, are comprised of over 300 compounds with different physiochemical characteristics. JP-4 is classified as a LNAPL with a liquid density of approximately 0.75 grams per milliliter (g/mL) at 20°C. Many compounds within JP-4 sorb very well to soil and are concentrated in the capillary fringe because the mixture is less dense than water. JP-4 is slightly soluble in water, with a maximum solubility of approximately 300 mg/L. JP-4 is also a primary substrate for biological metabolism. Simultaneous biodegradation of aliphatic, aromatic, and alicyclic hydrocarbons has been observed. In fact, mineralization rates of hydrocarbons in mixtures, such as JP-4, may be faster than mineralization of the individual constituents as a result of co-metabolic pathways (Jamison *et al.*, 1976; Perry, 1984).

The BTEX compounds are generally volatile, highly soluble in water, and adsorb less strongly to soil. These characteristics allow the BTEX compounds to leach more rapidly from contaminated soil into ground water and migrate as dissolved-phase contamination (Lyman *et al.*, 1992). All of the BTEX compounds are highly amenable to *in situ* degradation by both biotic and abiotic mechanisms.

Benzene is very volatile, with a vapor pressure of 76 millimeters of mercury (mm Hg) at 20°C and a Henry's Law Constant of approximately 0.0054 atmosphere-cubic meter/mole (atm-m^3/mole) at 25°C (Hine and Mookerjee, 1975; Jury *et al.*, 1984). The solubility of benzene in water at 20°C has been reported to be 1,780 mg/L (Verschueren, 1983). Benzene is normally biodegraded to carbon dioxide with catechol as a short-lived intermediate (Hopper, 1978; Ribbons and Eaton, 1992).

Toluene is also volatile, with a vapor pressure of 22 mm Hg at 20°C and a Henry's Law Constant of about 0.0067 atm-m^3/mole at 25°C (Pankow and Rosen, 1988; Hine and Mookerjee, 1975). Toluene sorbs more readily to soil media relative to benzene, but is still very mobile. The solubility of toluene in water at 20°C is approximately 515 mg/L at 20°C (Verschueren, 1983). Toluene has been shown to degrade to pyruvate, caetaldehyde, and completely to carbon dioxide via the intermediate catechol (Hopper, 1978; Wilson *et al.*, 1986; Ribbons and Eaton, 1992).

Ethylbenzene has a vapor pressure of 7 mm Hg at 20°C and a Henry's Law Constant of 0.0066 atm-m3/mole (Pankow and Rosen, 1988; Valsaraj, 1988). Ethylbenzene sorbs more

strongly to soils than benzene but less strongly than toluene (Abdul *et al.*, 1987). Ethylbenzene is also less soluble than benzene and toluene in water at 152 mg/L at 20°C (Verschueren, 1983; Miller *et al.*, 1985). Ethylbenzene ultimately degrades to carbon dioxide via its intermediate 3-ethylcatechol (Hopper, 1978; Ribbons and Eaton, 1992).

The three xylene isomers have vapor pressures ranging from 7 to 9 mm Hg at 20°C and Henry's Law Constants of between 0.005 and 0.007 atm-m^3/mole at 25°C (Mackay and Wolkoff, 1973; Hine and Mookerjee, 1975; Pankow and Rosen, 1988). Of all of the BTEX compounds, xylenes sorb most strongly to soil, but still can leach from soil into the ground water (Abdul *et al.*, 1987). Xylenes have water solubilities of 152 to 160 mg/L at 20°C (Bohon and Claussen, 1951; Mackay and Shiu, 1981; Isnard and Lambert, 1988). Xylenes can degrade to carbon dioxide via pyruvate carbonyl intermediates (Hopper, 1978; Ribbons and Eaton, 1992).

Based on these physiochemical characteristics, intrinsic remediation, soil vapor extraction, bioventing, biosparging, ground water extraction, and air stripping technologies could all be effective at destroying, collecting, and treating BTEX contaminants at UST Site 870.

6.2.3 Site-Specific Conditions

Two general categories of site-specific characteristics were considered in identifying remedial technologies to comparatively evaluate as part of this demonstration project. The first category considered was physical characteristics such as ground water depth, gradient, and flow direction, and soil type, and their influence on the types of remedial technologies most appropriate for the site. The second category involved assumptions about future land use and potential exposure pathways. Each of these site-specific characteristics have influenced the selection of remedial alternatives included in the comparative evaluation.

6.2.3.1 Ground Water and Soil Characteristics

Site geology and hydrogeology will have a profound effect on the transport of contaminants and the effectiveness and scope of required remedial technologies at a site. Hydraulic conductivity is perhaps the most important aquifer parameter governing ground water flow and contaminant transport in the subsurface. The velocity of the ground water and dissolved-phase contamination is directly related to the hydraulic conductivity of the saturated zone. Rising-head slug tests completed at UST Site 870 indicate a relatively high hydraulic conductivity within and downgradient of the source area and dissolved-phase BTEX plume. Estimated values ranged from 1.67×10^{-2} to 8.31×10^{-3} cm/s. These high values are

characteristic of sandy materials (see Sections 4 and 5 of this report). The high hydraulic conductivity of shallow sediments at this site directly influences the fate and transport of contaminants. The shallow ground water plume has migrated rapidly, increasing the areal extent of contamination (i.e., plume expansion) but decreasing the average concentration within the aquifer via dilution and increased biodegradation.

Although high hydraulic conductivity can result in plume expansion and migration, this same characteristic will also enhance the effectiveness of other remedial technologies, such as ground water extraction, biosparging, and intrinsic remediation. For example, it should be less expensive and time-consuming to capture and treat the contaminant plume using a network of extraction wells in areas of high hydraulic conductivity than to implement this technology in aquifers with low hydraulic conductivity. Contaminant recovery may also be maximized when contaminants are not significantly sorbed and retarded by phreatic soil. The relatively low TOC content of Hill AFB aquifer materials (<0.094 percent) should tend to minimize sorption and increase the mobility of all BTEX compounds. The effectiveness of biosparging may also be increased in highly conductive aquifers because of reduced entry pressures and increased sparging well radius of influence. Greater hydraulic conductivity also increases the amount of contaminant mass traveling through the biosparging network. The DO introduced by biosparging can also be utilized effectively to aerobically biodegrade the dissolved contaminant mass.

The rapid movement of contaminants within the subsurface away from the source will also increase the effectiveness of natural biodegradation processes by distributing the contaminant mass into areas enriched with electron acceptors. To satisfy the requirements of indigenous microbial activity and intrinsic remediation, the aquifer must provide an adequate and available carbon or energy source, electron acceptors, essential nutrients, proper ranges of pH, temperature, alkalinity, salinity, and redox potential.

Data collected as part of the field work phase of this demonstration project and described in Sections 3 and 4 of this document, indicate that UST Site 870 is characterized by an adequate and available carbon/energy source, electron acceptors, and essential nutrients to support measurable biodegradation of JP-4 contamination by indigenous microorganisms. Both DO and nitrate represent significant sources of electron acceptor capacity for the biodegradation of BTEX compounds in ground water at the site. Further, because fuel-hydrocarbon-degrading microorganisms have been known to thrive under a wide range of temperature and pH conditions (Freeze and Cherry, 1979), the physical and chemical

conditions of the ground water and phreatic soil at UST Site 870 are not likely to inhibit microorganism growth.

Fuel hydrocarbon-degrading microorganisms are ubiquitous, and as many as 28 hydrocarbon-degrading isolates (bacteria and fungi) have been discovered in different soil environments (Davies and Westlake, 1977; Jones and Eddington, 1968). Indigenous microorganisms have a distinct advantage over microorganisms injected into the subsurface to enhance biodegradation as indigenous microorganisms are well adapted to the physical and chemical conditions of the subsurface in which they reside (Goldestein *et al.*, 1985). Microbe addition was not considered a viable remedial technology for UST Site 870.

6.2.3.2 Potential Exposure Pathways

An exposure assessment identifies the potential human and ecological receptors that could potentially come into contact with site-related contamination and the pathways through which these receptors might be exposed. To have a complete exposure pathway, there must be a source of contamination, a potential mechanism(s) of release, a pathway of transport to an exposure point, an exposure point, and a receptor. If any of these elements do not exist, the exposure pathway is considered incomplete, and receptors cannot come into contact with site-related contamination. Evaluation of the potential long-term effectiveness of any remedial technology or remedial alternative as part of this demonstration project includes determining if the approach will be sufficient and adequate to minimize plume expansion so that potential exposure pathways involving shallow ground water are incomplete.

Assumptions about current and future land use at a site form the basis for identifying potential receptors, potential exposure pathways, reasonable exposure scenarios, and appropriate remediation goals. USEPA (1991) advises that the land use associated with the highest (most conservative) potential level of exposure and risk that can reasonably be expected to occur should be used to guide the identification of potential exposure pathways and to determine the level to which the site must be remediated. The source area consists of an industrial fuel storage and office facilities associated with mission support services. Warehouses, offices, and other large structures are located to the east and west of UST Site 870. A portion of the Patriot Hills Base Housing Area is located to the south and southwest of the source area. The ground water plume originating from UST Site 870 is migrating to the southwest, and has impacted shallow ground water underlying this residential area. Hill AFB elementary school is located immediately southwest of the housing area on the base's

southwestern property boundary. Thus, the current land use within and downgradient of the contaminant plume is both industrial and residential.

Under reasonable current land use assumptions, potential receptors include both worker and residential populations. It is unlikely that workers could be exposed to site-related contamination in phreatic soils or shallow ground water unless this material was removed during future construction, excavations or remedial activities. Utility workers could be exposed to shallow ground water contamination if the plume migrates to and discharges into the storm drain located along Cambridge Street. Shallow ground water is not currently used to meet industrial demands at Hill AFB. All onbase water demands are met by deep supply wells and/or from water piped in from the nearby Weber Basin Water Conservancy District. Exposure pathways involving other environmental media such as shallow soils and soil gas in the source area were not considered as part of this project, but should be considered in overall site remediation decisions.

Because of the depth of ground water (>5 feet), current residents should not be exposed to site-related contamination in ground water and phreatic soil under normal exposure conditions appropriate for the site. The most conservative exposure assumption involving ground water would involve uncontrolled or domestic use of ground water as a potable water supply. Although this exposure scenario can be an important consideration in deciding whether or not to take action at a site, it is not reasonable under current land use conditions. As noted previously, shallow ground water is not used to meet domestic potable water demands at Hill AFB at this time. Hill AFB officials could apply land use restrictions or institutional controls in the residential area to prevent residential use of ground water. It is possible that residents could be directly exposed to shallow ground water contamination at the storm drain located along Cambridge Street as ground water may surface at this location. Potential current exposure pathways involving other environmental media such as soil gas beneath residential units were not considered as part of this demonstration. Other studies have addressed the potential of soil gas and have determined that pathways to residential areas are incomplete.

Assumptions about hypothetical future land uses must also be made to ensure that the remedial technology or alternative considered for shallow ground water at the site is adequate and sufficient to provide long-term protection. No changes in land use are anticipated in the foreseeable future. Use of the residential land use assumption is the most conservative (health-protective). Thus, potential future receptors include both worker and residential populations. The potential future exposure pathways involving workers are identical to those under current conditions provided shallow ground water is not used to meet industrial water

demands. The potential future exposure pathways involving residents will also be identical to current conditions if Hill AFB can effectively restrict shallow ground water use in all areas potentially affected by contamination from UST Site 870. In summary, the use of the intrinsic remediation technology at this site will require that the source area be maintained as industrial property and that restrictions on ground water use be enforced in areas downgradient of UST Site 870 to the Cambridge Street stormwater drain. If source removal technologies such as soil vapor extraction, bioventing, mobile LNAPL recovery, biosparging, or ground water pump and treat are implemented, or expanded, they will also impact the short- and long-term land use options and will require some level of institutional control during and following remediation.

6.2.3.3 Remediation Goals for Shallow Ground Water

The stormwater drain located along Cambridge Street has been identified as the point of compliance (POC) for ground water remedial activities because this appears to be the most likely point of exposure for migrating contamination to impact human or ecological receptors. Migration to and discharge of contaminated shallow ground water into the stormwater system could complete an exposure pathway to human or ecological receptors via dermal contact or possible ingestion. The stormwater drain outfall into Pond 5 is an accessible and well-defined location for monitoring and for demonstrating compliance with protective ground water quality standards, such as federal MCLs.

This remedial strategy would be consistent with remediation requirements set forth by the State of Utah. The State recognizes that compliance with promulgated, single-point remediation goals is not necessary if site-related contamination does not pose a threat to human health or the environment (i.e., the exposure pathway is incomplete). Thus, the magnitude of required remediation in areas that can and will be placed under institutional control is different from the remediation that is required in areas that may be available for unrestricted use. This means that viable remedial alternatives, which includes long-term restrictions on shallow ground water use, must be able to achieve concentrations that minimize plume migration and expansion and potential human risk associated with ground water contact. The remediation goal for shallow ground water impacting the Cambridge Street stormwater drain is attainment of federal MCLs for each of the BTEX compounds, as listed in Table 6.1. Although it is unlikely that stormwater would be ingested by humans, this level of long-term protection is appropriate for a residential area.

TABLE 6.1

POINT-OF-COMPLIANCE REMEDIATION GOALS
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

Compound	Federal MCLs (µg/L)
Benzene	5
Toluene	1,000
Ethylbenzene	700
Total Xylenes	10,000

In summary, available data indicate that no potential exposure pathway involving shallow ground water is complete under current conditions, with the exception of soil gas emanating from the ground water to within 4 feet of the surface. The exposure route for soil gas was identified in a vapor exposure assessment performed in other site characterization studies (Gemperline, written communication, 1995). Although an exposure pathway to the surface is completed from BTEX contamination volatilizing from ground water, human risk was calculated to be inconsequential. Other than soil gas, no potential exposure pathway involving shallow ground water will be complete under future land use assumptions provided use of ground water as a potable or industrial source of water is prohibited by institutional controls within and downgradient of the source area to the Cambridge Street stormwater drain. Thus, institutional controls are likely to be a necessary component of any ground water remediation strategy for this site. The required duration of these institutional controls may vary depending on the effectiveness of any remedial technology at reducing contaminant mass and concentrations in the ground water. If Federal MCLs are exceeded in the Cambridge Street stormwater discharge, remediation of stormwater will be required to prevent pathway completion.

6.2.4 Summary of Remedial Technology Screening

Several remedial technologies were identified and screened for use in reducing the source of BTEX and for treating the shallow ground water at UST Site 870. Table 6.2 identifies the initial remedial technologies considered for this demonstration and those retained for more detailed analysis. Screening was conducted systematically by considering the objectives of the AFCEE intrinsic remediation demonstration, the physiochemical properties of BTEX compounds, and other site-specific characteristics such as hydrology, land use assumptions,

TABLE 6.2

INITIAL TECHNICAL IMPLEMENTABILITY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR GROUND WATER REMEDIATION UST SITE 870 INTRINSIC REMEDIATION EE/CA HILL AFB, UTAH

General Response Action	Technology Type	Process Option	Implementability	Retain
Long-Term Monitoring	Periodic Ground Water Monitoring	Confirmation Wells	Many existing wells are available to confirm the progress of remediation.	Yes
		Point-of-Compliance Wells	Sufficient distance exists between the plume and point-of-compliance to locate several wells.	Yes
Institutional Controls	Ground Water Use Control	Land Use Control/Regulate Well Permits	Plume area is currently within the base boundary and land-use and ground water use are under base jurisdiction.	Yes
		Seal/Abandon Existing Wells	No production wells are known to exist in the existing or predicted plume area.	No
		Point-of-Use Treatment	No ground water is extracted from the plume area for any use.	No
	Public Education	Meetings/ Newsletters	Base public relations and environmental management offices have many information avenues to inform workers and residents.	Yes
Containment of Plume	Hydraulic Controls	Passive Drain Collection	Existing stormwater drain near Cambridge Street partially intercepts ground water. Drain could be expanded.	Yes
		Minimum Pumping/Gradient Control	A line or semicircle of vertical pumping wells could be located along the leading edge of plume to intercept and halt the advance of the plume.	Yes
	Physical Controls	Slurry Walls/Grout Curtains	Requires significant disruption of a residential area.	No
		Sheet Piling	Requires significant disruption of a residential area.	No
	Reactive/Semi-Permeable Barriers	Biologically Active Zones	Natural biodegradation of BTEX compounds can be stimulated by allowing contaminated ground water to flow through an aquifer zone which has enhanced oxygen and nutrient conditions.	Yes

TABLE 6.2 (Continued)

INITIAL TECHNICAL IMPLEMENTABILITY SCREENING OF
TECHNOLOGIES AND PROCESS OPTIONS FOR GROUND WATER REMEDIATION
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

General Response Action	Technology Type	Process Option	Implementability	Retain
In Situ Treatment	Biological	Oxygen and Nutrient Enhanced Biodegradation	Differs from biologically active zone in that oxygen and nutrients are injected upgradient of plume and allowed to migrate downgradient. In theory, this method can more rapidly reduce higher BTEX concentrations in and immediately downgradient of the source area.	Yes
	Chemical/ Physical	Intrinsic Remediation	A combination of natural biological, chemical, and physical removal mechanisms which occur to varying degrees on every site. Ground water sampling at UST Site 870 indicates that this is a major, ongoing remediation process.	Yes
		Air Sparging (Volatilization)	Injection of air into contaminated aquifer creating a mass transfer of BTEX into air bubbles and into vadose zone. Limited radius of influence and short-circuiting are common problems.	No
Aboveground Ground Water Treatment	Ground Water Extraction	Vertical Pumping Wells	Entire ground water plume is pumped by installing numerous wells with submersible pumps. High cost and major disruption to residential area.	No
		Downgradient Horizontal Drains	See Passive Drain Collection.	Yes
	Biological	Bioreactors	High flow rates require excessive retention times and large reactors. BTEX is often volatilized in these systems.	No
	Chemical/ Physical	Air Stripping	Cost-effective technology for removing varying concentrations of BTEX at higher flow rates. Potential permitting for air emissions.	Yes
		Activated Carbon	Cost prohibitive for more concentrated BTEX. Creates a carbon disposal problem.	No
		UV/Ozone Reactors	High flow rates require excessive retention times and large, expensive reactors.	No

TABLE 6.2 (Continued)

INITIAL TECHNICAL IMPLEMENTABILITY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR GROUND WATER REMEDIATION
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

General Response Action	Technology Type	Process Option	Implementability	Retain
Aboveground Treatment	Direct Discharge to Industrial Waste Water Treatment Plant (IWWTP)		Viable option when an IWWTP is available and capable of handling BTEX and hydraulic loading.	Yes
Treated Ground Water Disposal	Discharge to IWWTP or Sanitary Sewer	IWWTP	Viable option when access to industrial sewer exists and hydraulic loading is acceptable.	Yes
		Sanitary Sewer	Viable option when access to sanitary sewer exists and hydraulic loading is acceptable.	Yes
	Treated Ground Water Reinjection	Vertical Injection Wells	Not recommended due to clogging and high maintenance.	No
		Injection Trenches	Less clogging than wells but still require large trenches and can be subject to injection well permitting.	Yes
	Discharge to Surface Waters	Storm Drains	Viable option but generally requires NPDES or other discharge permit.	Yes
Source Removal/Soil Remediation	Mobile LNAPL Recovery	Dual-Pump Systems	Best suited for sites with >1 foot mobile LNAPL where aboveground ground water treatment already exists	No
		Skimmer Pumps/Bailers/ Wicks	Best suited for sites with <1 foot mobile LNAPL where ground water pumping is undesirable.	Yes
		Total Fluids Pumping	Best suited for sites with thin saturated zones where excessive ground water will not be pumped.	Yes
		Bioslurping	Combined vapor extraction, bioventing, and mobile LNAPL recovery system has been operated at the site with limited success.	Yes
	Excavation/ Treatment	Biological Landfarming	Deep excavation is not feasible at this site due to surface structures.	No

TABLE 6.2 (Concluded)

INITIAL TECHNICAL IMPLEMENTABILITY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR GROUND WATER REMEDIATION
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

General Response Action	Technology Type	Process Option	Implementability	Retain
	Excavation/ Treatment (cont'd)	Thermal Desorption	Deep excavation is not feasible at this site due to surface structures.	No
	In Situ	Bioventing	Air injection to stimulate biodegradation of fuel residuals. System currently operating in source area.	Yes
		Soil Vapor Extraction	Vapor extraction has been successfully implemented at other Hill AFB sites. Requires expensive off-gas treatment.	Yes

potential exposure pathways, and appropriate remediation goals. All of these factors will influence the technical effectiveness, implementation, and relative cost of technologies for remediating shallow ground water underlying and migrating from the site.

The general response actions retained for consideration in the development of remedial alternatives include long-term monitoring institutional controls, *in situ* treatment (intrinsic remediation), plume containment, bioventing, soil vapor extraction, mobile LNAPL removal and ground water collection and aboveground treatment (air stripping) and ground water disposal in the base industrial waste water treatment plant (IWTP).

6.3 BRIEF DESCRIPTION OF REMEDIAL ALTERNATIVES

This section describes how remedial technologies retained from the screening process were combined into three remedial alternatives for UST Site 870. Sufficient information on each remedial alternative has been provided to facilitate a comparative analysis of effectiveness, implementability, and cost in Section 6.4.

6.3.1 Alternative 1 - Continued Mobile LNAPL Removal and Bioventing in Source Area, Intrinsic Remediation, Institutional Controls with Long-Term Monitoring

Mobile LNAPL recovery operations have been underway at UST Site 870 for over 1 year. To date, approximately 700 gallons of JP-4 have been recovered from one skimmer pump and 5 to 7 wells with sorbent wicks located in the source area. Limited bioventing is also underway in the source area. A two-well bioventing system is currently injecting air into the subsurface and providing oxygen to approximately 15,000 cubic yards of the most contaminated vadose soils. Under this alternative, existing mobile LNAPL removal and bioventing activities would be continued, but no additional source removal technologies would be employed. Because the area of remediation under this alternative is limited to soils north of Sixth Street and because LNAPL recovery is a slow process, it is estimated that a 5-percent annual reduction in source BTEX will occur with this alternative.

Intrinsic remediation is achieved when naturally occurring attenuation mechanisms bring about a reduction in the total mass of a contaminant in the soil or dissolved in ground water. Intrinsic remediation results from the integration of several subsurface attenuation mechanisms that are classified as either destructive or nondestructive. Destructive attenuation mechanisms include biodegradation, abiotic oxidation, and hydrolysis. Nondestructive attenuation mechanisms include sorption, dilution (caused by dispersion and infiltration), and volatilization. In some cases, intrinsic remediation will reduce dissolved-phase contaminant

concentrations below numerical concentration goals, thus protecting human health and the environment. Based on the existing evidence of intrinsic remediation described in Sections 4 and 5, these processes are occurring and will continue to reduce contaminant mass as the plume advances. Figures 5.9, 5.10, and 5.11 illustrate the projected BTEX plume migration and concentration reductions that should take place when 5 percent of the BTEX source is removed each year through limited mobile LNAPL recovery and bioventing. Based on model predictions, the BTEX plume will approach the Cambridge Street storm drain in approximately 1 to 4 years at concentrations exceeding 1 μg/L. During years 4 through 7, the Bioplume II model predicts that the combination of source reductions and intrinsic remediation within the BTEX plume will significantly reduce its size and concentration.

A 5-percent annual LNAPL recovery/reduction was selected as a reasonable removal rate of BTEX concentrations emanating from mobile LNAPL at the site. A 5-percent annual BTEX source recovery/reduction could accomplish this. The most important physical processes contributing to BTEX source weathering are volatilization and dissolution. The dissolution of BTEX compounds from LNAPL is accomplished through interfacial dissolution at the fuel/water interface and dissolution into precipitation that is percolating downward."

The 5-percent annual BTEX loss was selected for comparison purposes only, and is not intended to reflect an actual rate of BTEX source reduction. On the basis of previous fuel-spill investigations in similar soils at Wurtsmith AFB, BTEX constituents in mobile LNAPL decreased at rates exceeding 70 percent per year through natural weathering (Parsons ES, 1995). Approximately 1,500 gallons of JP-4 released into a shallow, sandy aquifer at Wurtsmith AFB in October 1988 had weathered to low residual-phase concentrations (<150 μg/L) without measurable free-product by June 1991. BTEX compounds in LNAPL are being similarly weathered at UST 870, as seen by a decrease in BTEX concentrations in LNAPL over time (Table 4.1). The LNAPL sample taken from MW-10 exhibited a 70-percent loss of BTEX constituents relative to fresh LNAPL (JP-4). Hence, the partitioning strength of BTEX compounds in LNAPL contamination is diminishing not only from engineered removal (bioslurpers), but also from natural weathering. Regardless of the value used to estimate annual BTEX source reductions, the calibrated model predicts that groundwater will not migrate past the base boundary, with the front of the plume stabilizing near Cambridge Street (assuming current conditions are not compromised with further fuel spills). The BTEX plume is expected to disappear from overwhelming natural attenuation mechanisms once BTEX source concentrations are reduced to approximately 50 percent of their current concentration.

Implementation of Alternative 1 would require the use of institutional controls such as land use restrictions and long-term monitoring. Land use restrictions may include placing long-term restrictions on soil excavation within the source area and ground water well installations within and downgradient of the source area. The intent of these restrictions would be to reduce potential receptor exposure to contaminants by legally restricting activities within areas affected by site-related contamination.

As a minimum, ground water monitoring would be conducted twice annually as part of this remedial technology to evaluate the progress of natural attenuation processes. Based on the potential plume migration, the Cambridge Street stormwater drain could be impacted by benzene at concentrations approaching the federal MCL of 5 μg/L. Section 7 discusses the proposed locations of a POC sampling point located at the stormwater drain outfall and three POC wells that would be used to identify the potential migration of contaminated ground water into or beyond the Cambridge Street stormwater sewer. These wells would be screened across the first 5 to 10 feet of the shallow aquifer to provide some early warning of the advance of the plume toward the base boundary. In addition to these wells, the stormwater discharge from the Cambridge Street sewer would also be monitored to verify hydraulic connection between the shallow ground water and this potential pathway. Detection of benzene in excess of 5 μg/L at the POC wells or stormwater discharge point would trigger a reevaluation of remedial options to ensure that MCLs are not exceeded at the stormwater discharge point.

Public education on the selected alternative will be developed to inform base personnel and residents of the scientific principles underlying source reduction and intrinsic remediation. This education could be accomplished through public meetings, presentations, press releases, and posting of signs where appropriate. Periodic site reviews could also be conducted every year using data collected from the long-term ground water monitoring program. The purpose of these periodic reviews would be to evaluate the extent of contamination, assess contaminant migration and attenuation over time, document the effectiveness of institutional controls at the site, and reevaluate the need for additional remedial actions at the site.

6.3.2 Alternative 2 - Continued Mobile LNAPL Recovery and Bioventing, Intrinsic Remediation, Institutional Controls with Long-term Ground Water Monitoring, Stormwater Treatment

This alternative is identical to Alternative 1 except that it includes a provision for stormwater treatment if MCLs are exceeded at the stormwater discharge point. Construction

of a passive ground water collection trench was considered but deemed unnecessary given the very low concentration of BTEX expected near the storm drain. Aboveground treatment of stormwater using a portable sparging tank will be included to ensure that benzene concentrations in excess of MCLs do not pose a threat to human or ecological receptors at the stormwater discharge pond. Stormwater would be treated using a simple air sparging tank that would strip BTEX compound from the stormwater prior to discharge to the pond. This alternative would supplement intrinsic remediation by ensuring that any ground water with BTEX concentrations exceeding MCLs is treated before it completes a potential exposure pathway. As with Alternative 1, institutional controls and long-term monitoring would be required. The presence of benzene in excess of 5 µg/L at POC wells could also trigger the need for additional ground water remediation downgradient of Cambridge Street to ensure contaminated ground water does not migrate off-base.

A low-flow weir would be constructed at the stormwater discharge point to convey stormwater through the sparge tank at rates the system is capable of handling. In the event that stormwater runoff exceeds the capacity of the weir (and the sparge tank system), the excess stormwater will be discharged directly to collection ponds without treatment. Although excess water would not be treated, the anticipated risk of BTEX contamination would be very low due to dilution of the BTEX compounds.

6.3.3 Alternative 3 - Expanded Mobile LNAPL Removal and Bioventing, Intrinsic Remediation, Institutional Controls and Long-Term Monitoring

This remedial alternative couples several remedial technologies to more aggressively address both mobile LNAPL and residual LNAPL contamination in soil and ground water at UST Site 870. The objective of this alternative would be to more rapidly reduce the partitioning of BTEX from mobile LNAPL and soils and to ensure that no contaminated ground water migrated into or beyond the Cambridge Street stormwater drain. The source removal technologies considered for mobile LNAPL and residual LNAPL contamination in the soil and capillary fringe are mobile LNAPL recovery using LNAPL recovery pumps, soil vapor extraction, and bioventing.

A maximum of 4 feet of apparent floating mobile LNAPL was discovered at UST Site 870 during recent field investigations. Current mobile LNAPL recovery efforts are focused in the spill source area, although the estimated areal extent of mobile LNAPL contamination at the site extends downgradient of this area (Section 4). More intensive mobile LNAPL recovery could be accomplished by installing conventional skimmer pumps in available 4-inch ground

water monitoring wells containing mobile LNAPL. As a supplement to these pumps, it would also be necessary to install additional product recovery wells and total fluid recovery pumps downgradient of current product recovery wells. Any recovered product would be separated in an oil/water separator, and transported offsite for recycling or disposal in a permitted treatment, storage, and disposal facility for waste oil. It was assumed that contaminated water could be transported to the base industrial wastewater sewer system.

The leading edge of the migrating mobile LNAPL area shown in Figure 4.1 would be targeted for mobile LNAPL recovery. For estimating purposes five, 6-inch diameter mobile LNAPL recovery wells would be installed in a line between CPT-14 and MW-10 to more rapidly remove this source of BTEX contamination. A total-fluids recovery system is recommended to remove LNAPL and small quantities of water from this area. It is important to note that even in optimum, coarse-grained soils, a 30- to 50-percent recovery of the spilled fuel is considered excellent.

Much of the remaining 50 to 70 percent of the fuel is more tightly occluded and bound in the micropore structure of the soil. Removal of this residual fuel can be accomplished using either soil vapor extraction or bioventing technologies. Bioventing is an *in situ* process where low-flow air injection is used to enhance the biodegradation of organic contaminants in subsurface soils. Soil vapor extraction focuses on rapidly removing the volatile fraction of fuels through extracting soil vapor at higher rates. Both technologies have been successfully applied at JP-4 contaminated sites on Hill AFB (Hinchee, 1993) Bioventing is generally the technology of choice because unlike soil vapor extraction, bioventing uses a low rate of air injection that does not create vapor emissions to the atmosphere. Utah strictly limits VOC emissions, and the cost of soil vapor extraction is nearly doubled when vapor treatment is required. Although bioventing has been selected for this alternative, special flux monitoring will be required if air injection is proposed for the capillary fringe contamination beneath the residential area.

Extensive pilot- and full-scale testing of the bioventing technology at Hill AFB has resulted in significant reductions in soil BTEX and TPH. At Site 388, JP-4 jet fuel biodegradation rates were estimated at 2,500 milligrams of TPH per kilogram of soil per year (ES, 1994). Based on an estimated 60-foot radius of oxygen influence observed at Site 388, construction of a bioventing system at UST Site 870 could require approximately 11 vertical vent wells to influence the estimated 120,000 square feet of area with BTEX-impacted soils exceeding 50 mg/Kg total BTEX. Four-inch-diameter wells could be used, and screened intervals would be installed over the thin contaminated soil interval just above the water table. A single 20-

horsepower blower system should be capable of supplying air (oxygen) to this soil volume. Operational emphasis would be placed on the destruction of BTEX compounds in the capillary fringe to significantly reduce this source of continuing ground water contamination.

Although bioventing is primarily used to address vadose (unsaturated) soil contamination, field demonstrations have shown an increase in DO concentration levels in phreatic soil and ground water (Barr, 1993). The increase in DO concentrations within the capillary fringe and ground water can facilitate biodegradation of dissolved hydrocarbon contamination.

In order to estimate the potential impact of this more intensive source removal on the downgradient plume expansion, a 15-percent per year reduction in the BTEX source term was factored into the Bioplume II model. This assumes that the more extensive mobile LNAPL removal and bioventing systems will be able to remove BTEX three times faster than the current source removal rates assumed under Alternatives 1 and 2. Figure 5.13 illustrates the predicted BTEX plume migration after 3 years of more intensive source removal. The model predicts that after 3 years, BTEX concentration will approximately one-half of those encountered with Alternative 1 and 2 after the same 3-year period. Based on these model predictions, the combined effect of intensive source removal and intrinsic remediation would reduce the likelihood of benzene migration in excess of its MCL beyond the POC wells and into the Cambridge Street storm drain. Under this scenario, the need for treatment of the stormwater discharge seems unlikely.

Although more intensive source removal would more rapidly decrease dissolved BTEX concentrations and accelerate intrinsic remediation, it would not eliminate the need for short-term institutional controls and long-term monitoring. The required time frame for institutional controls and long-term monitoring could be shortened by approximately 4 to 5 years if this alternative were implemented.

6.4 EVALUATION OF ALTERNATIVES

This section provides a comparative analysis of each of the three remedial alternatives based on the effectiveness, implementability, and cost criteria. A summary of this evaluation is found in Table 6.6 at the end of this section.

6.4.1 Alternative 1 - Continued Mobile LNAPL Removal and Bioventing in Source Area, Intrinsic Remediation, Institutional Controls with Long-Term Monitoring

6.4.1.1 Effectiveness

Section 5 of this document presents the results of the Bioplume II model completed to support the intrinsic remediation alternative at UST Site 870. The potential impacts of remaining mobile LNAPL on ground water contamination over time were incorporated into the model for this remedial alternative. Only the existing product recovery and bioventing systems in the spill area were included in this alternative because of the increasing cost and reduced efficiency of trying to recover a more dispersed mobile LNAPL layer in downgradient areas.

This assessment predicted that natural attenuation mechanisms will significantly limit contaminant migration and reduce contaminant mass and toxicity. However, the model predicted a potential exceedance of the federal MCL for benzene at the POC wells (Figure 7.1) and a potential risk of exposure at the outfall of the Cambridge Street stormwater drain. Because the Bioplume II model is based upon numerous conservative assumptions and does not fully account for the anaerobic biodegradation available due to sulfate and other electron acceptors, it is possible that benzene concentrations in excess of 5 μg/L will never reach the POC wells or storm drain. Semiannual ground water monitoring at the stormwater discharge point and the POC wells and other wells along the leading edge of the existing plume would be critical to ensuring the protectiveness of this alternative. This alternative would cease to be protective if the BTEX plume was intercepted by the storm drain and contaminated ground water was subsequently discharged into the stormwater pond.

The effectiveness of this remedial alternative requires that excavations or drilling within the source area be limited to properly protected site workers. Long-term land use restrictions will be required to ensure that shallow ground water will not be pumped or removed for potable use within, and approximately 500 feet in all directions from, the existing BTEX plume. Existing health and safety plans should be enforced to reduce risks from operating existing source reduction technologies and from installing and monitoring additional POC wells.

Compliance with program goals is one component of the long-term effectiveness evaluation criterion. Alternative 1 will satisfy program objectives designed to promote intrinsic remediation as a component of site remediation and to scientifically document naturally occurring processes.

Alternative 1 is based on the effectiveness of naturally occurring processes that minimize contaminant migration and reduce contaminant mass over time and the effectiveness of institutional controls. As described earlier, an investigation of the potential effectiveness of naturally occurring processes at UST Site 870 using field data and the Bioplume II model has demonstrated that the BTEX plume will be significantly reduced in size and mass in 4 to 7 years. The maximum distance traveled by the plume could be slightly beyond the Cambridge Street stormwater drain, however, the mass of the benzene will be significantly reduced during that time so that the maximum concentration of benzene reaching the stormwater drain is on the order of magnitude of the 5 μg/L MCL. The sensitivity analysis completed on the Bioplume II model for this site (Section 5) suggests that even under the most conservative (i.e., worst-case) conditions, the naturally occurring processes at UST Site 870 should significantly reduce contaminant migration to a potential exposure point (the stormwater drain located along Cambridge Street). Aside from the administrative concerns associated with long-term enforcement of long-term land use restrictions and long-term ground water monitoring programs, this remedial alternative should provide reliable, continued protection.

For cost comparison purposes, and based on Bioplume modeling results, it is assumed that source removal will continue for 8 years and that dissolved benzene concentrations will exceed MCLs throughout the plume for approximately 8 years under Alternative 1. The 8-year time frame is a reasonable source removal goal based on predictions of successful source removal, both engineered and natural, that will approach, or exceed, 5 percent annually (Section 6.3.1). An additional 5 years of semi-annual ground water monitoring will be required to ensure that intrinsic remediation has uniformly reduced all BTEX compounds to levels below federal MCLs, resulting in a total treatment/monitoring time of approximately 13 years.

6.4.1.2 Implementabilty

Alternative 1 is not technically difficult to implement. Continued operation of existing mobile LNAPL recovery and bioventing systems will require minimal new construction. Existing procedures for mobile LNAPL removal and recycling will be followed. Installation of POC ground water monitoring wells is a standard procedure at Hill AFB. Long-term management efforts will be required to ensure proper sampling procedures are followed. Periodic site reviews should be conducted to confirm the adequacy and completeness of long-term monitoring data and verify the effectiveness of this remediation approach. There may also be administrative concerns associated with long-term enforcement of ground water use restrictions. Future land use within the source area may be impacted by leaving contaminated

soil and ground water in place. Regulators and the public will have to be informed of the benefits and limitations of the intrinsic remediation option. Educational programs are not difficult to implement, and the initial regulatory reaction to this alternative has been positive.

6.4.1.3 Cost

The cost of Alternative 1 is summarized in Table 6.3. Capital costs are limited to the construction of three new POC wells. The estimated cost of maintaining existing mobile LNAPL recovery and bioventing systems for 8 years are included in the $372,000 present-worth cost estimate for Alternative 1. Also included are the costs of maintaining institutional controls and long-term ground water monitoring for a total of 13 years. The total present worth of this alternative is most sensitive to the estimated time requirement for intrinsic remediation to reduce benzene concentrations to less than the 5 µg/L MCL. Costs could be reduced by changing from semiannual to annual monitoring after the plume begins to recede.

6.4.2 Alternative 2 - Continued Mobile LNAPL Recovery and Bioventing in Source Area, Intrinsic Remediation, Institutional Controls with Long-Term Ground Water Monitoring, Stormwater Treatment

6.4.2.1 Effectiveness

The effectiveness of Alternative 1 is enhanced under Alternative 2 by ensuring that if stormwater becomes contaminated, an air stripping unit will be installed to treat ground water to levels below federal drinking water MCLs before it is discharged to the stormwater pond. As stated in Section 6.3.2, the use of a stormwater air stripper would be contingent on BTEX concentrations exceeding MCLs at the stormwater discharge point. Air stripping technologies, including sparging tanks, are proven and reliable systems for reducing BTEX compound concentrations in water by more than 95 percent. The use of a low-flow diversion weir to treat only more concentrated BTEX-contaminated stormwater will reduce the size and complexity of the air stripping system. This alternative also complies with the program goals because intrinsic remediation remains the predominant decontamination method at the site.

6.4.2.2 Implementability

The addition of a small stormwater treatment system at the stormwater discharge point near the stormwater pond does not present any unique implementation problems. A 230-volt power source and a concrete pad would be required to support the portable sparging tank system. Additional time would be required for base personnel to sample influent and effluent to the sparging tank. The use of a sparging tank will minimize maintenance time. Some

TABLE 6.3

ALTERNATIVE 1 - COST ESTIMATE
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

Capital Costs	**Cost**
Design/Construct Three POC Wells	$12,000
Operation, Maintenance and Monitoring Costs (Annual)	**Annual Cost**
Operate and Maintain Existing Mobile LNAPL Recovery and Bioventing Systems (8 years)	$18,000
Ground Water Monitoring (12 wells - Semiannually 13 Years)	$12,000
Maintain Institutional Controls/Public Education (13 years)	$6,000
Project Management (13 y..rs)	$8,000
Present Worth of Alternative 1[a]	**$372,000**

a/ Based on I=5%

accumulation of iron and manganese sludge and biological sludge will occur in the tank. A properly designed tank will have a conical bottom to draw off sludge without interrupting the treatment process. Waste sludge should be nonhazardous.

The installation of POC wells, the institutional controls and long-term monitoring commitments described in Alternative 1 will also be implemented with this alternative. If benzene exceeds 5 μg/L at POC wells, additional ground water remediation may be required to ensure that contaminated ground water is not migrating beyond the base boundary.

6.4.2.3 Cost

The cost of Alternative 1 will be increased by the stormwater treatment system and maintenance and monitoring of the system. Based on Bioplume II model predictions, the plume will begin to recede during the fourth year. For cost comparison purposes its is assumed that the stormwater treatment system will operate for 5 years to ensure that contaminated ground water is not discharged to the stormwater pond. As with Alternative 1,

source reduction technologies would continue for 8 years under Alternative 2. Annual long-term monitoring would continue for an ditional 5 years to ensure that intrinsic remediation is reducing contaminant concentrations below MCLs throughout the plume. The estimated capital and operating costs of Alternative 2 are shown in Table 6.4. The total present worth cost of Alternative 2 is $455,000.

6.4.3 Alternative 3 - Intensive Source Removal, Intrinsic Remediation, Institutional Controls and Long-Term Monitoring

6.4.3.1 Effectiveness

More intensive source removal coupled with intrinsic remediation and long-term monitoring should reduce the dissolved-phase BTEX plume concentrations and significantly reduce potential exposure at the Cambridge Street stormwater discharge. If a greater percentage of the mobile LNAPL could be removed and soil BTEX concentrations could be significantly reduced, the partitioning of BTEX into ground water would be reduced, thereby promoting a more rapid decrease in contaminant mass, mobility, and toxicity. It was assumed that mobile LNAPL removal and bioventing would continue for approximately 4 years. During these 4 years, the site model assumed that the total BTEX mass in the soil would be reduced by 60 percent and that average dissolved benzene concentrations at the center of the plume would be reduced to less than 5 μg/L as a result of intrinsic remediation.

Conceptually, this 15-percent annual reduction in a BTEX source from mobile LNAPL will be obtained from both natural weathering and increased engineered removal. Natural weathering rates of BTEX compounds in mobile LNAPL under similar conditions can be substantial (Section 6.3.1). Similar weathering losses of JP-4 contamination are occurring at Site UST 870. The assumed 15-percent annual reduction of BTEX constituents in mobile LNAPL does not necessarily represent actual weathering rates, but show potential LNAPL reduction rates as a result of increased LNAPL removal along with natural weathering. More intensive source removal could help achieve protectiveness approximately 4 years sooner than that under Alternative 1. The model predicts that with more intensive source removal, the BTEX plume will be less concentrated approaching the Cambridge Street stormwater drain, and this exposure pathway may not be completed.

Site workers would have to handle and be exposed to larger volumes of extracted mobile LNAPL. Bioventing in the source area and downgradient smear zones would be an effective

TABLE 6.4

ALTERNATIVE 2 - COST ESTIMATE
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

Capital Costs	**Cost**
Three POC Wells	$12,000
Stormwater Treatment System	$24,000
Operation, Maintenance and Monitoring Costs (Annual)	**Annual Cost**
Operate Existing Mobile LNAPL Recovery/Bioventing Systems (8 years)	$18,000
Operate and Monitor Stormwater Treatment System (5 years)	$14,000
Ground Water Monitoring (12 wells - Semiannually 13 Years)	$12,000
Maintain Institutional Controls/Public Education (13 years)	$6,000
Project Management (13 years)	$8,000
Present Worth of Alternative 2[a]	**$455,000**

a/ Based on I=5%.

method of reducing the BTEX which could partition into shallow ground water. The toxicity of the soil would also be more rapidly reduced. Bioventing has been shown to preferentially remove BTEX compounds and reduce toxicity in soils (Miller, 1993). If air injection is used beneath the residential area, additional monitoring will be required to ensure that vapors do not migrate upward into occupied buildings.

The more aggressive source removal component of this remedial alternative satisfies the statutory preference for using treatment to more rapidly reduce contaminant mobility and toxicity. Long-term natural attenuation processes will also reduce contaminant toxicity, mobility, and volume in ground water. Long-term land restrictions should be implemented to ensure that shallow ground water will not be available for use as a potable water source downgradient of the source area. A health and safety plan would be developed to mitigate

risks from installing and operating the expanded mobile LNAPL recovery and bioventing system, and installing and monitoring POC wells. Thus, this remedial alternative should also minimize contaminant migration and provide long-term protection.

Alternative 3 also satisfies the program objectives of demonstrating the potential effectiveness of intrinsic remediation for minimizing plume expansion and reducing BTEX mass and toxicity. However, this remedial alternative will result in the generation of additional mobile LNAPL, ground water, drill cuttings, and other wastes requiring treatment and/or disposal. Alternative 3 (intensive source removal, intrinsic remediation, and long-term monitoring) should provide reliable, continuous protection with little risk from temporary system failures.

6.4.3.2 Implementability

Installing and operating a more intensive mobile LNAPL recovery, and bioventing system to remove the source of BTEX contamination at UST Site 870 will present additional implementability concerns. Installation involves standard drilling practices for wells, and limited excavation for piping and manifold connections. Implementation in and around residential areas would be disruptive to residents and their yards. Mobile LNAPL recovery and bioventing equipment is available, and small systems are already in place in the UST Site 870 spill area. Extraction wells required for product recovery represent a well-developed technology that has been proven at numerous sites. Bioventing is an innovative technology that has been used effectively at other JP-4 contaminated sites at Hill AFB. Implementation of this remedial alternative would also require flux monitoring during bioventing startup to confirm that soil vapors are not transmitted upward into residential buildings. Annual *in situ* respiration testing is also required to verify that the system is working as expected. The technical and administrative implementability concerns associated with the intrinsic remediation and long-term monitoring component of this remedial alternative are identical to those discussed in Alternative 1, except the time frame is approximately 4 years shorter.

6.4.3.3 Cost

The total present worth of this alternative is estimated at $782,000. The cost differential between Alternatives 2 and 3 is sensitive to the extent and duration of required LNAPL recovery, bioventing operations, and the accuracy of intrinsic remediation modeling results. Table 6.5 lists the costs for Alternative 3 based on a mobile LNAPL removal period of 4 years and a bioventing period of 4 years. During years 4 through 9, semiannual ground water

TABLE 6.5

ALTERNATIVE 3 - COST ESTIMATE
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

Capital Costs	**Cost**
Design/Construct 5 Mobile LNAPL Recovery Wells and Collection Systems	$98,000
Design/Construct 11-Well Bioventing System	$363,000
Design/Construct Three POC Wells	$12,000
Operation, Maintenance and Monitoring Costs (Annual)	**Annual Cost**
Operate New Mobile LNAPL Recovery/ Bioventing Systems (4 years)	$36,200
Ground Water Monitoring (12 wells - Semiannually Years 1-9)	$12,000
Maintain - Institutional Controls/Public Education (9 years)	$6,000
Project Management (9 years)	$8,000
Present Worth of Alternative 3[a/]	**$782,000**

a/ Based on i=5%.

monitoring will be conducted to verify that intrinsic remediation is reducing dissolved BTEX contaminants to levels below MCLs.

6.5 RECOMMENDED REMEDIAL APPROACH

Three multicomponent alternatives have been evaluated for remediation of the shallow ground water at UST Site 870. Alternatives evaluated include two levels of source removal, intrinsic remediation with long-term monitoring, and an alternative which would treat stormwater if it contained benzene or other BTEX compounds in excess of MCLs. Table 6.6 summarizes the results of this evaluation based upon effectiveness, implementability and cost criteria. Based on this evaluation, the Air Force recommends Alternative 2 as the best combination of risk reduction and cost effectiveness to achieve RAOs for dissolved-phase BTEX in UST Site 870 ground water.

Only marginal reductions in plume migration and risk reduction will be achieved if more intensive source removal is applied to the downgradient smear zone. These marginal reductions will come at a significant increase in cost and significant disturbance to a residential area during additional mobile LNAPL recovery well and bioventing system construction. Based on all effectiveness criteria, Alternative 2 will make maximum use of intrinsic remediation to reduce plume migration and toxicity while providing the assurance that if MCLs are exceeded at the stormwater discharge point, an effective treatment system can be rapidly installed to prevent completion of a very conservative exposure pathway.

All of the remedial alternatives are implementable, however, Alternative 2 significantly minimizes potential disruptions to base housing residents and should be acceptable to the public and regulatory agencies because it is protective of human health and the environment. Implementation of Alternative 2 will require land use and ground water use controls to be enforced for approximately 8 to 13 years with semiannual ground water monitoring. The cost of Alternatives 1 and 2 could be reduced if annual ground water monitoring is implemented once the plume began to recede.

The final evaluation criterion used to compare each of the three remedial alternatives was cost. It is the opinion of the Air Force that the additional cost of Alternative 2 over Alternative 1 is justified by the additional protection it provides. In contrast, the additional cost of Alternative 3 can not be justified by the marginal reduction in treatment and monitoring time that is gained from more intensive source removal.

TABLE 6.6
SUMMARY OF REMEDIAL ALTERNATIVE EVALUATION
GROUND WATER REMEDIATION
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

Remedial Alternative	Effectiveness	Implementability	Present Worth Cost Estimate
Alternative 1			$372,000
- Limited Source Removal - Intrinsic Remediation - Long-Term Monitoring	Continued mobile LNAPL removal and bioventing will gradually remove BTEX source. Contaminant mass, volume and toxicity will be significantly reduced over next seven years. MCL for benzene could be exceeded at POC.	Readily implementable. Long-term management, ground water use controls and monitoring required for an estimated 13 years. Minimal exposure of site workers if excavation is carefully controlled in source area.	
Alternative 2			$455,000
- Limited Source Removal - Intrinsic Remediation - Optional Stormwater Treatment - Long-Term Monitoring	Similar to Alternative 1 except it provides additional protection against benzene discharge into stormwater ponds and potential completion of exposure pathways to humans or ecological receptors. Portable sparging tank should be very effective in removing low levels of BTEX prior to discharge to pond.	Readily implementable. Long-term management, ground water controls, and monitoring required for an estimated 13 years. Would also require minor construction at stormwater outfall and operation of a simple sparging tank for approximately 5 years.	
Alternative 3			$782,000
- Expanded Mobile LNAPL Removal and Bioventing - Intrinsic Remediation - Long-Term Monitoring	Most effective in reducing soil contamination and more rapidly reducing source of ground water contamination. May prevent BTEX from impacting POC wells if implemented immediately (1995). Could result in increased generation of secondary waste streams that would require additional treatment and disposal.	Difficult to implement in residential area without disruption and potential secondary risk to residents. Could reduce long-term management, ground water use controls and monitoring by 4-5 years compared to Alternative 1 and 2. Increased drilling and system maintenance will increase site worker exposure to contaminated soils and mobile LNAPL.	

SECTION 7

ONG-TERM MONITORING PLAN

7.1 OVERVIEW

As discussed in Section 6, the preferred remedial option for the fuel-hydrocarbon contamination present in ground water at UST Site 870 is Alternative 2. This alternative consists of continued mobile LNAPL recovery and bioventing for mobile- and residual-phase LNAPL contamination, and intrinsic remediation with LTM for contaminated ground water. In addition, this alternative has a provision for treatment of stormwater discharge should BTEX compounds in excess of MCLs be detected in stormwater runoff at the stormwater drain outfall. In keeping with the requirements of this remedial alternative, a LTM plan must be developed. The purpose of LTM is to assess site conditions over time, confirm the effectiveness of naturally occurring processes in reducing contaminant mass and minimizing contaminant migration, validate/calibrate the Bioplume II model, and evaluate the need for additional remediation.

The LTM plan consists of identifying the location of two separate ground water monitoring networks and developing a ground water and stormwater discharge point sampling and analysis strategy. The strategy described in this section is designed to monitor plume migration and attenuation over time to verify that intrinsic remediation of dissolved-phase BTEX is occurring at rates sufficient to protect potential receptors.

7.2 MONITORING NETWORKS

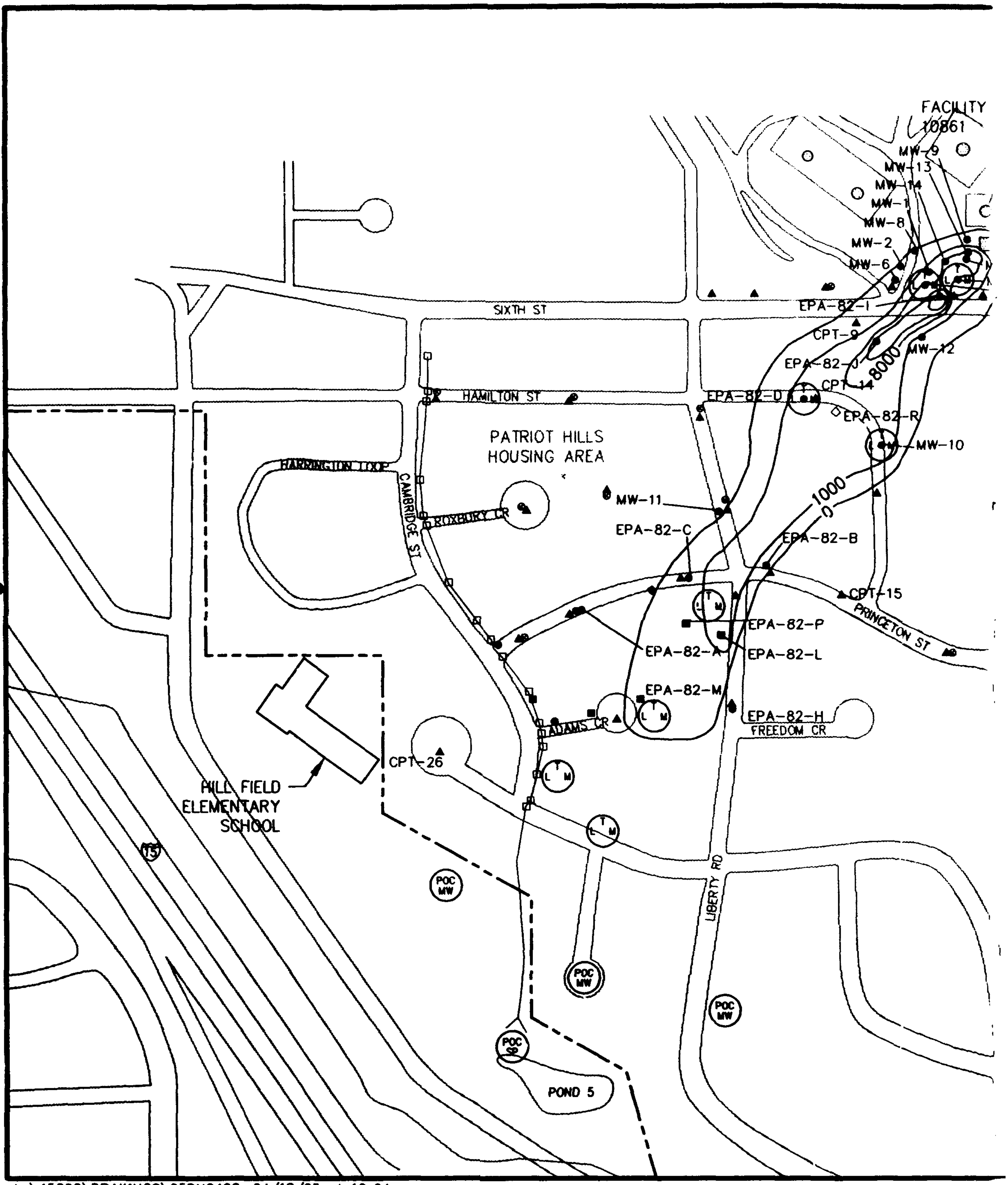
Two separate ground water monitoring networks will be used at UST Site 870 as part of the intrinsic remediation remedial alternative LTM plan. The first network will consist of eight LTM wells located upgradient, within, and downgradient of the observed total BTEX plume. The purpose of the LTM well network is to provide short-term confirmation and verification of intrinsic remediation and to verify the results of the Bioplume II model. The second network of ground water monitoring points will consist of three POC wells and a POC

sampling point at the Pond 5 outfall of the stormwater drain located along Cambridge Street. The purpose of the POC monitoring network is to verify that no BTEX compounds in concentrations exceeding MCLs migrate beyond the area under institutional control. Should BTEX compounds be detected in the stormwater drain discharge, installation and operation of the stormwater treatment system discussed in Section 6 will be implemented. Should BTEX compounds be detected in POC wells above MCLs, other remedial options will be evaluated.

7.2.1 Long-Term Monitoring Network

Eight ground water monitoring wells placed upgradient, within, and immediately downgradient of the existing BTEX contaminant plume will be used to monitor the effectiveness of intrinsic remediation in reducing total contaminant mass and minimizing contaminant migration. Figure 7.1 shows the proposed locations of these wells. One new and four existing monitoring wells (MW-04, MW-05, EPA-82-D and MW-10) will be used as LTM wells to monitor natural attenuation within the anaerobic treatment zone and BTEX concentrations in the source area. In the event that MW-04 is screened to shallow to permit an accurate ground water sample, monitoring wells EPA-82-I, MW-01, or MW-14 should be considered as a substitute LTM location. One new LTM well should be placed within the aerobic treatment zone to monitor natural attenuation within this zone. One new LTM well should be placed downgradient of the BTEX plume. Sampling and analysis of the downgradient LTM well (and the POC wells) will be useful in monitoring changes in ground water chemistry through time and will facilitate early detection of plume migration. Because the velocity of the dissolved-phase BTEX plume is retarded relative to the advective ground water velocity and the velocities of the electron acceptors are not, depleted DO, nitrate, and sulfate concentrations, and elevated ferrous iron and methane concentrations will advance in front of the BTEX plume. Thus, changes in the concentrations of the electron acceptors can be used to provide early warning of BTEX plume encroachment on the LTM and POC wells.

An existing CPT monitoring point (CPT-40) should be used as an upgradient LTM well. CPT-40 was selected as an upgradient LTM point because it has historically been free of ground water contamination and is suited for monitoring background levels of ground water electron acceptors, pH, and oxidation/reduction potential. The different well diameter of CPT-40 compared to the other proposed LTM wells is not a sampling issue because background levels of ground water parameters are presumed to be uniform throughout the



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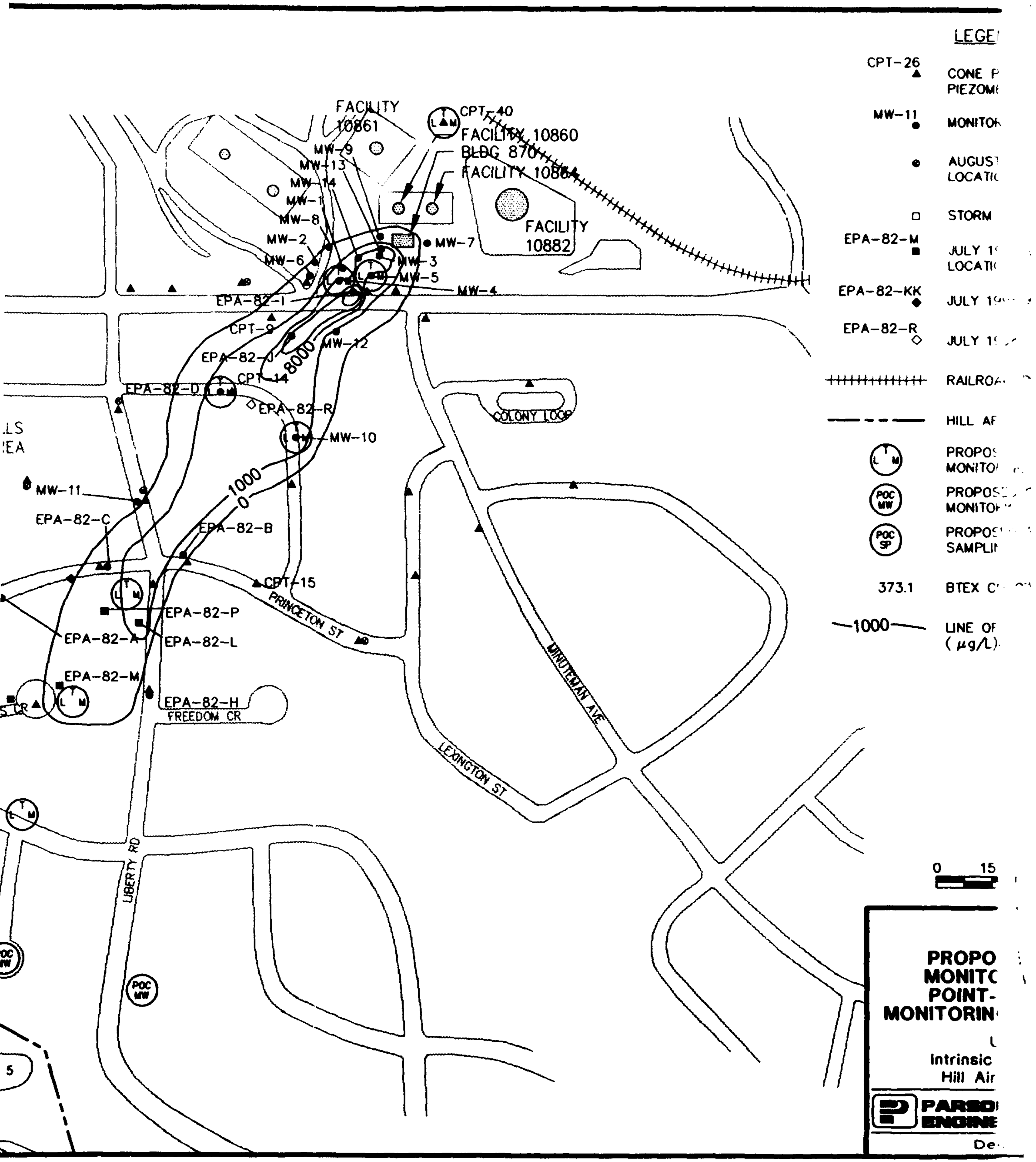

LEGEN
CPT-26
CONE P
PIEZOM
MW-11
MONITOR
AUGUST
LOCATIO
STORM
EPA-82-M
JULY 1
LOCATIO
EPA-82-KK
JULY 19
EPA-82-R
JULY 19
RAILROA
HILL AF
PROPOS
MONITO
PROPOS
MONITO
PROPOS
SAMPLI
373.1
BTEX C
1000
LINE OF
(μg/L)
FACILITY 10861
CPT-40
FACILITY 10860
BLDG 870
FACILITY 10884
FACILITY 10882
MW-9
MW-13
MW-14
MW-1
MW-8
MW-2
MW-6
MW-7
MW-3
MW-5
MW-4
EPA-82-I
CPT-9
EPA-82-J
8000
MW-12
CPT-14
EPA-82-D
EPA-82-R
COLONY LOOP
MW-10
MW-11
1000
0
EPA-82-C
EPA-82-B
CPT-15
PRINCETON ST
EPA-82-P
EPA-82-A
EPA-82-L
EPA-82-M
EPA-82-H
FREEDOM CR
MINUTEMAN AVE
LEXINGTON ST
LIBERTY RD
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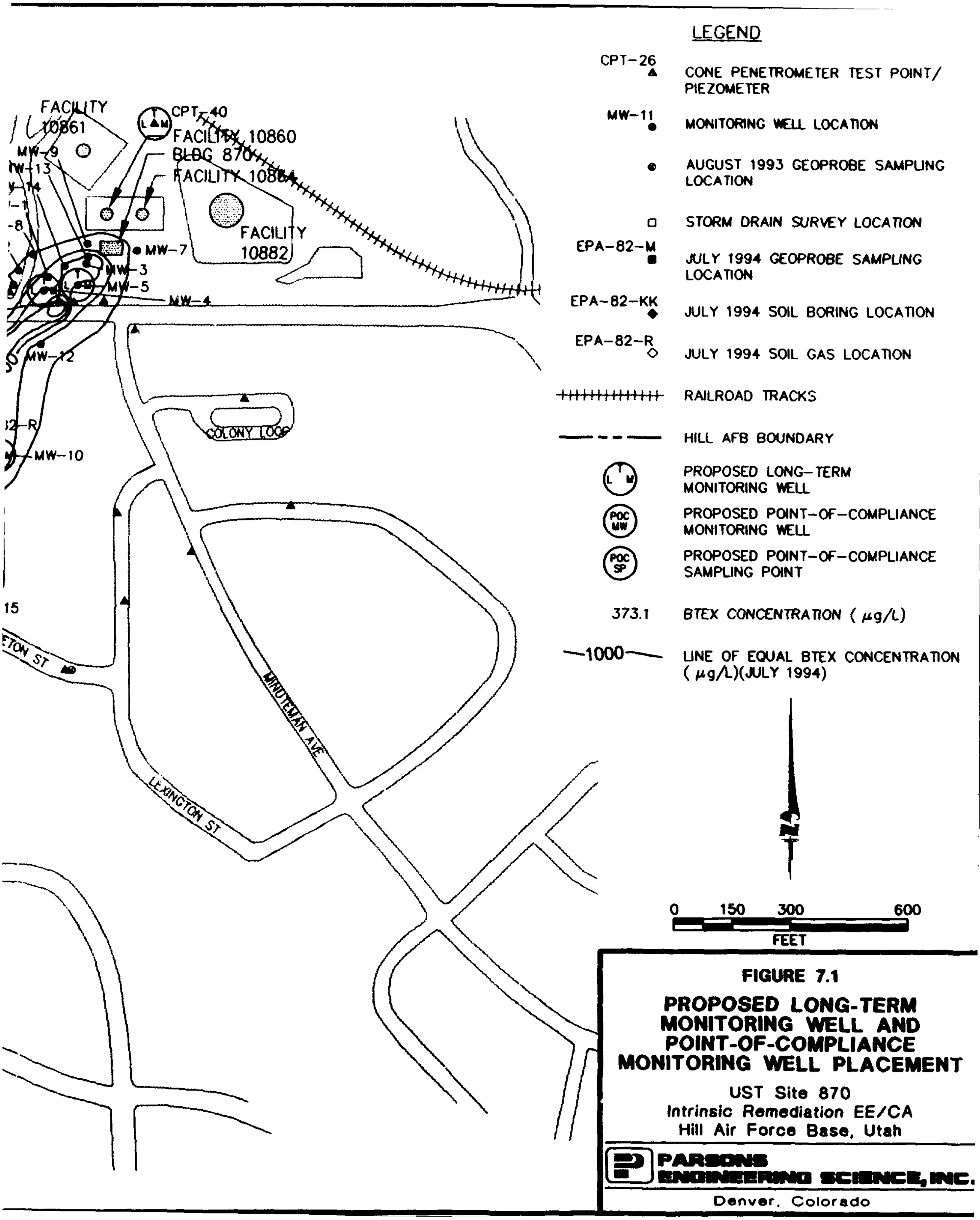

FIGURE 7.1

PROPOSED LONG-TERM MONITORING WELL AND POINT-OF-COMPLIANCE MONITORING WELL PLACEMENT

UST Site 870
Intrinsic Remediation EE/CA
Hill Air Force Base, Utah

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

the shallow aquifer. In the case that CPT-40 is destroyed or inaccessible, a new LTM well (described in Section 7) well be installed instead.

The LTM network will supplement the POC monitoring network in monitoring plume migration and will allow model predictions to be validated. Such monitoring of the plume will allow additional response time if BTEX concentrations within the plume are increasing or if the plume begins to migrate further than expected. New LTM wells should be constructed of 2-inch PVC with 5 to 10 feet of 0.010-inch-slotted screen. The screened interval should be within the same stratigraphic horizon as the contaminant plume. The screened interval should be chosen so that the base of the screen coincides with the interface between the sandy saturated zone and the underlying competent clay to silty clay and the top of the screen is above the seasonal high water table.

7.2.2 Point-of-Compliance Monitoring Network

Three new POC monitoring wells should be installed to verify that no contaminated ground water exceeding MCLs migrates beyond the area under institutional control.. Figure 7.1 shows the proposed locations for the POC wells and the stormwater drain sampling point. POC sampling points will be used to demonstrate protection of human health and the environment and compliance with site-specific numerical remediation goals (i.e., MCLs for the BTEX constituents).

As described for the LTM wells, the POC wells also should be screened in the same hydrogeologic unit as the contaminant plume. Data presented in this report concerning the nature and extent of contamination at the site suggest that a 5- to 10-foot screen extending from slightly above the ground water table to the interface between the sandy saturated zone and the underlying competent clay to silty clay confining unit should be used to monitor changes in ground water chemistry at these locations. New POC wells should be constructed of 2-inch PVC and a 0.010-inch slotted screen should be used.

7.3 GROUND WATER SAMPLING AND ANALYSIS

To ensure that sufficient contaminant removal is occurring at UST Site 870 to protect human health and the environment and meet site-specific remediation goals, the LTM plan includes a comprehensive sampling and analysis plan. To supplement the LTM sampling and

analysis plan presented herein, a site-specific ground water sampling and analysis plan should be prepared prior to initiating the LTM program.

7.3.1 Analytical Protocol

7.3.1.1 Long-Term Monitoring Well Analytical Protocol

All LTM wells will be sampled and analyzed to monitor trends in ground water chemistry and to verify the effectiveness of intrinsic remediation at the site. Water level measurements are to be made during each sampling event. All ground water samples from LTM wells will be analyzed according to the analytical protocol presented in Table 7.1. A site-specific ground water sampling and analysis plan should be prepared using this analytical protocol prior to initiating the LTM program.

7.3.1.2 Point-Of-Compliance Monitoring Point Analytical Protocol

All POC sampling points will be sampled and analyzed to monitor trends in ground water chemistry, to verify the effectiveness of intrinsic remediation at the site, and to demonstrate protection of human health and the environment and compliance with site-specific numerical remediation goals. Water level measurements are to be made in POC wells during each sampling event. All ground water samples from POC wells will be analyzed according to the analytical protocol presented in Table 7.2. All water samples from the POC stormwater drain outfall sampling location should be sampled for aromatic hydrocarbons only. A site-specific ground water sampling and analysis plan should be prepared using this analytical protocol prior to initiating the LTM program.

7.3.2 Frequency

Each of the LTM and POC sampling points will be sampled twice each year for 13 years. If the data collected during this time period supports the anticipated effectiveness of the intrinsic remediation alternative at this site, the sampling frequency can be reduced to once every year for all wells in the LTM program, or eliminated. If the data collected at any time during the monitoring period indicate the need for additional remedial activities at the site (i.e., by exceeding MCLs at POC locations) sampling frequency should be adjusted accordingly.

TABLE 7.1

LONG-TERM MONITORING ANALYTICAL PROTOCOL
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

Analyte	Method/Reference	Comments	Data Use	Recommended Frequency of Analysis	Sample Volume, Sample Container, Sample Preservation	Field or Fixed-Base Laboratory
Ferrous (Fe^{2+})	Colorimetric A3500-Fe D	Field only	Elevated ferrous iron concentrations may be indicative of the anaerobic biodegradation process of iron reduction	Semiannually	Collect 100 mL of water in a glass container; acidify with hydrochloric acid per method	Field
Ferrous (Fe^{2+})	Colorimetric HACH 25140-25	Alternate method; field only	Elevated ferrous iron concentrations may be indicative of the anaerobic biodegradation process of iron reduction	Semiannually	Collect 100 mL of water in a glass container	Field
Temperature	E170.1	Field only	Metabolism rates for microorganisms depend on temperature	Semiannually	N/A	Field
Dissolved Oxygen	Dissolved oxygen meter	Refer to Method A4500 for a comparable laboratory procedure	The oxygen concentration is a data input to the Bioplume II model; concentrations less than 1 mg/L generally indicate an anaerobic pathway	Semiannually	Collect 300 mL of water in biochemical oxygen demand bottles; analyze immediately; alternately, measure dissolved oxygen in situ	Field
pH	E150.1/SW9040, direct reading meter	Protocols/Handbook methods[a/]	Aerobic and anaerobic processes are pH-sensitive	Semiannually	Collect 100–250 mL of water in a glass or plastic container; analyze immediately	Field
Conductivity	E120.1/SW9050, direct reading meter	Protocols/Handbook methods	General water quality parameter used as a marker to verify that site samples are obtained from the same ground water system	Semiannually	Collect 100–250 mL of water in a glass or plastic container	Field
Nitrate (NO_3^{-1})	IC method E300 or method SW9056; colorimetric, method E353.2	Method E300 is a Handbook method; method SW9056 is an equivalent procedure	Substrate for microbial respiration if oxygen is depleted	Semiannually	Collect up to 40 mL of water in a glass or plastic container; cool to 4°C; analyze within 48 hours	Fixed-base

TABLE 7.1 (CONCLUDED)

LONG-TERM MONITORING ANALYTICAL PROTOCOL
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

Analyte	Method/Reference	Comments	Data Use	Recommended Frequency of Analysis	Sample Volume, Sample Container, Sample Preservation	Field or Fixed-Base Laboratory
Sulfate (SO_4^{-2})	IC method E300 or method SW9056 or HACH SulfaVer 4 method	Method E300 is a Handbook method; method SW9056 is an equivalent procedure. HACH method is Photometric	Substrate for anaerobic microbial respiration	Semiannually	Collect up to 40 mL of water in a glass or plastic container; cool to 4°C	Fixed-base or field (for HACH method)
Redox potential	A2580 B	Measurements are made with electrodes; results are displayed on a meter; samples should be protected from exposure to atmospheric oxygen	The redox potential of ground water influences and is influenced by biologically mediated reactions; the redox potential of ground water may range from more than 200 mV to less than -400 mV	Semiannually	Collect 100–250 mL of water in a glass container, filling container from bottom; analyze immediately	Field
Methane	RSKSOP-114 modified to analyze water samples for methane by headspace sampling with dual thermal conductivity and flame ionization detection.	Method published and used by the US Environmental Protection Agency Robert S. Kerr Laboratory	The presence of methane suggests BTEX degradation via an anaerobic pathway utilizing carbon dioxide (carbonate) as the electron acceptor (methanogenesis)	Semiannually	Collect water samples in 40 mL volatile organic analysis (VOA) vials with butyl gray/Teflon-lined caps (zero headspace); cool to 4°C	Fixed-base
Aromatic hydrocarbons (BTEX)	Purge and trap GC method SW8020	Handbook method; analysis may be extended to higher molecular weight alkylbenzenes	BTEX is the primary target analyte for monitoring natural attenuation; BTEX concentrations must also be measured for regulatory compliance	Semiannually	Collect water samples in a 40 mL VOA vial with zero headspace; cool to 4°C; add hydrochloric acid to pH 2	Fixed-base

a/ Protocol methods are presented by Wiedemeier *et al.*, 1994

TABLE 7.2

POINT-OF COMPLIANCE MONITORING ANALYTICAL PROTOCOL
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

Analyte	Method/Reference	Comments	Data Use	Recommended Frequency of Analysis	Sample Volume, Sample Container, Sample Preservation	Field or Fixed-Base Laboratory
Temperature	E170.1	Field only	Well development	Semiannually	N/A	Field
Dissolved Oxygen	Dissolved oxygen meter	Refer to method A4500 for a comparable laboratory procedure	The oxygen concentration is a data input to the Bioplume model; concentrations less than 1 mg/L generally indicate an anaerobic pathway	Semiannually	Collect 300 mL of water in biochemical oxygen demand bottles; analyze immediately; alternately, measure dissolved oxygen in situ	Field
pH	E150.1/SW9040, direct reading meter	Protocols/Handbook methods[a]	Aerobic and anaerobic processes are pH-sensitive	Semiannually	Collect 100–250 mL of water in a glass or plastic container; analyze immediately	Field
Conductivity	E120.1/SW9050, direct reading meter	Protocols/Handbook methods	General water quality parameter used as a marker to verify that site samples are obtained from the same ground water system	Semiannually	Collect 100–250 mL of water in a glass or plastic container	Field
Redox potential	A2580 B	Measurements are made with electrodes; results are displayed on a meter; samples should be protected from exposure to atmospheric oxygen	The redox potential of ground water influences and is influenced by biologically mediated reactions; the redox potential of ground water may range from more than 200 mV to less than -400 mV	Semiannually	Collect 100–250 mL of water in a glass container, filling container from bottom; analyze immediately	Field
Aromatic hydrocarbons (BTEX)	Purge and trap GC method SW8020	Handbook method; analysis may be extended to higher molecular weight alkylbenzenes	BTEX is the primary target analyte for monitoring natural attenuation; BTEX concentrations must also be measured for regulatory compliance	Semiannually	Collect water samples in a 40 mL VOA vial with zero headspace; cool to 4°C; add hydrochloric acid to pH 2	Fixed-base

a/ Protocol methods are presented by Wiedemeier *et al.*, 1994

SECTION 8

CONCLUSIONS AND RECOMMENDATIONS

This report presents the results of an EE/CA conducted by Parsons ES in conjunction with researchers from the USEPA RSKERL to determine the potential for intrinsic remediation of, and to develop an appropriate remedial alternative for, BTEX compounds dissolved in the shallow ground water at UST Site 870, Hill AFB, Utah. Previous investigations determined that JP-4 jet fuel had been released into the soil and shallow ground water at the site through POL operations. Chemical analysis of a sample of mobile LNAPL confirms that residual- and mobile-phase LNAPL contamination at the site is probably dominated by weathered JP-4 jet fuel. The main emphasis of the work described herein was to evaluate the potential for naturally occurring degradation mechanisms to reduce dissolved-phase fuel-hydrocarbon concentrations in ground water to levels that are protective of human health and the environment.

To collect the data necessary for the intrinsic remediation demonstration, Parsons ES and USEPA researchers collected soil and ground water samples from the site. Physical and chemical data collected under this program were supplemented with data collected during previous site characterization events. Site-specific geologic, hydrologic, and laboratory analytical data were then used in the Bioplume II numerical ground water model to simulate the effects of advection, dispersion, sorption, and biodegradation on the fate and transport of the dissolved-phase BTEX plume. Extensive site-specific data were used for model implementation. Model parameters that could not be obtained from existing site data were estimated using widely accepted literature values for sediments similar to those found at the site. Conservative aquifer parameters were used to construct the Bioplume II model for this study, and therefore, the model results presented herein represent a worst-case scenario. Actual dissolved-phase BTEX degradation rates observed during LTM at the site will probably be greater than predicted by this study. This will result in faster removal rates for the BTEX compounds and a shorter plume migration distance than predicted by the Bioplume II model.

The Bioplume II model predicts that the BTEX plume will approach the stormwater drain that runs parallel to Cambridge Street in 1 to 4 years at concentrations of approximately 1 μg/L. After this time, the plume will recede somewhat and reach steady-state equilibrium (continuous source), or will continue to recede until the plume disappears (source reduction). Ground water geochemistry suggests that DO, nitrate, ferric hydroxide, sulfate, and carbon dioxide present in site ground water have the capacity to assimilate at least 31,370 μg/L of total BTEX. The highest plausible total BTEX concentration observed at the site was 26,576 μg/L in August 1992. Based on site observations, ground water at the POL site has enough assimilative capacity to degrade dissolved-phase BTEX that partitions from the LNAPL plume into the ground water before the plume migrates 1,600 feet downgradient from the source area.

The results of the modeling effort and the intrinsic remediation demonstration indicate that dissolved-phase petroleum hydrocarbon contamination present in ground water poses no significant risk to human health or the environment in its present known, or predicted future, concentration and distribution. It is therefore recommended that intrinsic remediation with LTM be implemented for dissolved-phase BTEX contamination found in ground water at this site. To reduce sources of continuing contamination, it is also recommended that mobile LNAPL recovery operations and bioventing activities currently operating at the site be continued.

To verify the predictions made during the Bioplume II modeling effort and to monitor the long-term migration and degradation of the contaminant plume, it is recommended that eight LTM wells, three POC monitoring wells, and a POC sampling location be used at the mouth of the stormwater drain that runs along Cambridge Street and empties into Pond 3. Regular sampling and analysis of ground water from these sampling points will allow sufficient time to implement hydraulic controls to contain the plume if BTEX compounds are detected in the POC wells. These wells should be sampled on a semiannual basis for 13 years. If site conditions indicate that the contaminant plume is receding or gone at this time or sooner, sampling can be discontinued. Ground water samples should be analyzed for the analytes described in Section 7 of this report. If BTEX concentrations in ground water in the Cambridge Street stormwater discharge or POC wells are found to exceed MCLs, additional corrective actions should be implemented to remediate ground water at the site, as described in this report.

SECTION 9

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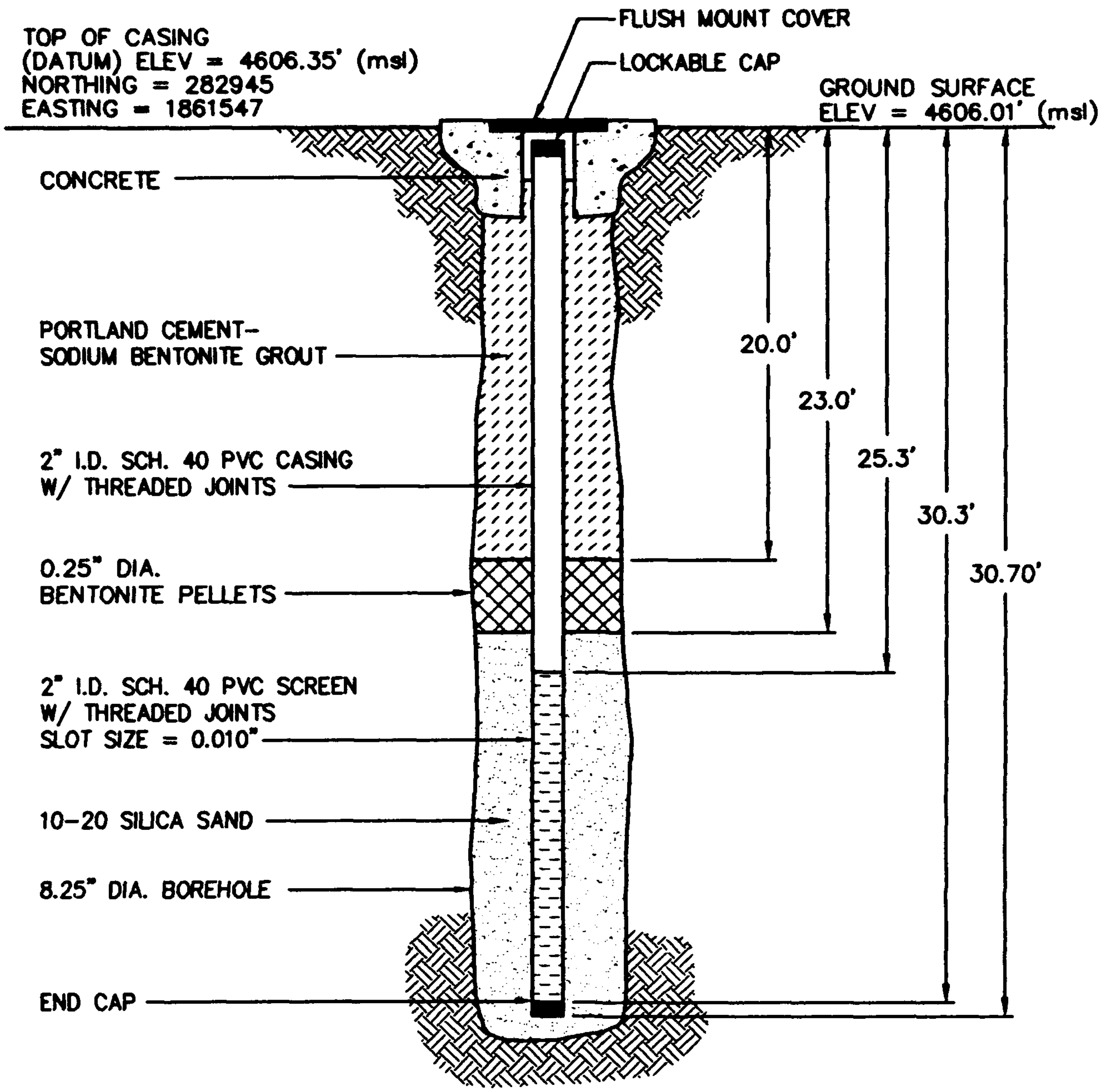
APPENDIX A

BORING LOGS, WELL COMPLETION DIAGRAMS, AND SLUG TEST RESULTS



NOT TO SCALE

LEGEND

msl MEAN SEA LEVEL

INSTALLATION DATE: 8/17/93

DRILLING CONTRACTOR: USEPA

GEOLOGIST: T.WIEDEMEIER, ES
J.BERNARD, ES

WELL COMPLETION DIAGRAM
MONITORING WELL: EPA-82A

Hill Air Force Base, Utah

ENGINEERING-SCIENCE, INC.

Denver, Colorado

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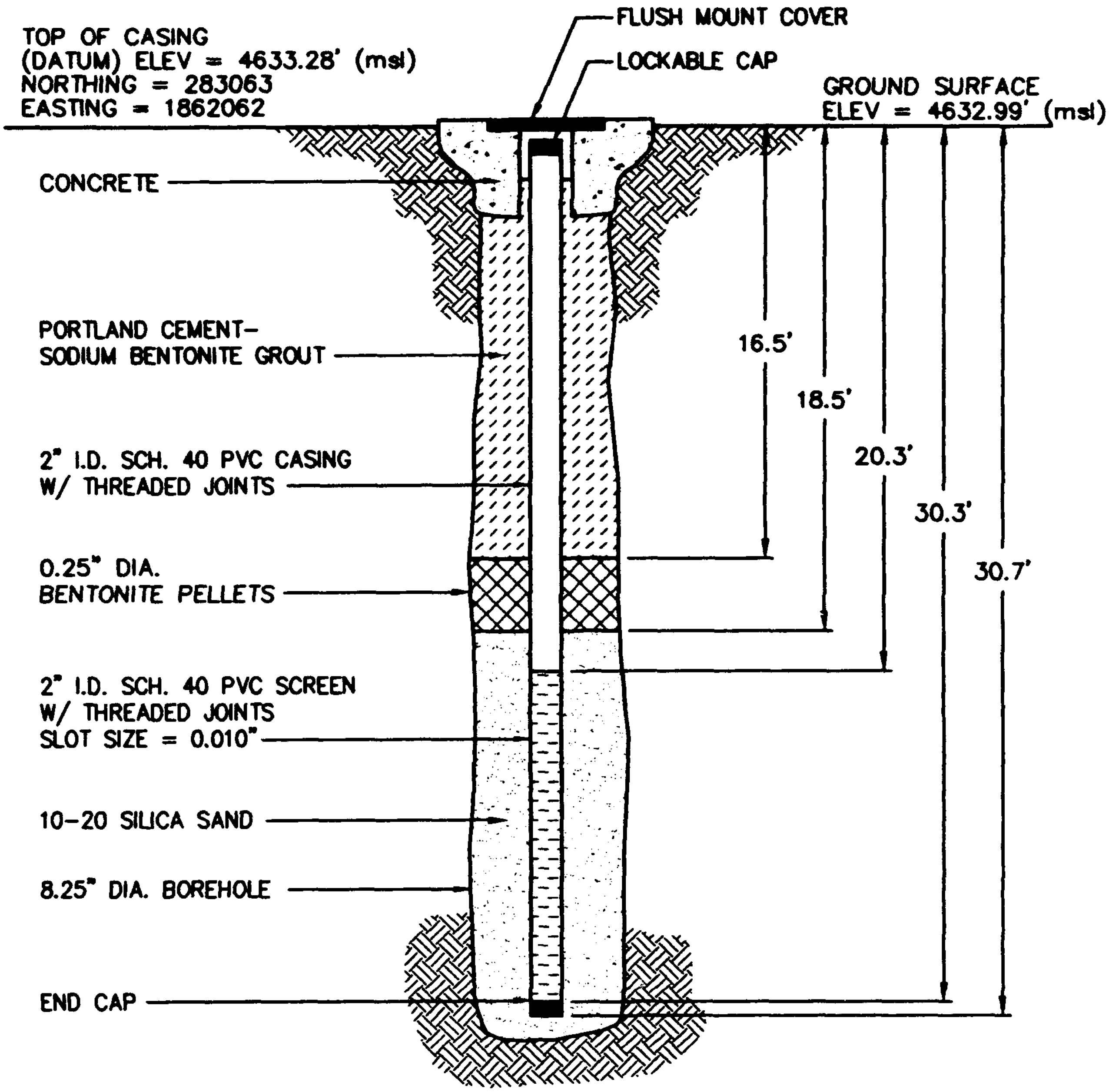

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LEGEND

msl MEAN SEA LEVEL

INSTALLATION DATE: 8/18/93

DRILLING CONTRACTOR: USEPA

GEOLOGIST: T.WIEDEMEIER, ES
J.BERNARD, ES

WELL COMPLETION DIAGRAM
MONITORING WELL: EPA-82B

Hill Air Force Base, Utah

ENGINEERING-SCIENCE, INC.

Denver, Colorado

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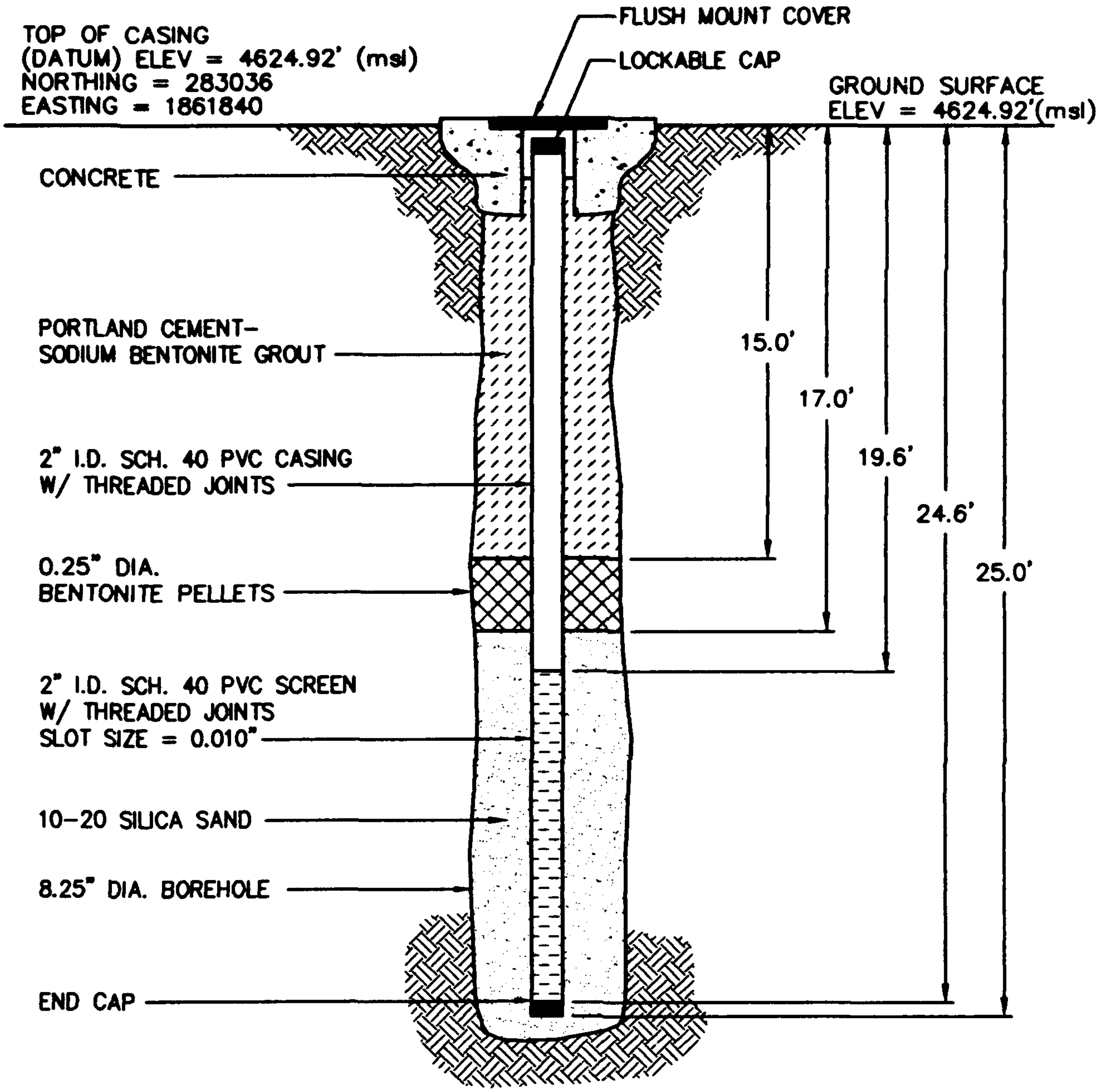

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msl MEAN SEA LEVEL

INSTALLATION DATE: 8/19/93

DRILLING CONTRACTOR: USEPA

GEOLOGIST: J.BERNARD, ES

WELL COMPLETION DIAGRAM
MONITORING WELL: EPA-82C

Hill Air Force Base, Utah

ENGINEERING-SCIENCE, INC.

Denver, Colorado

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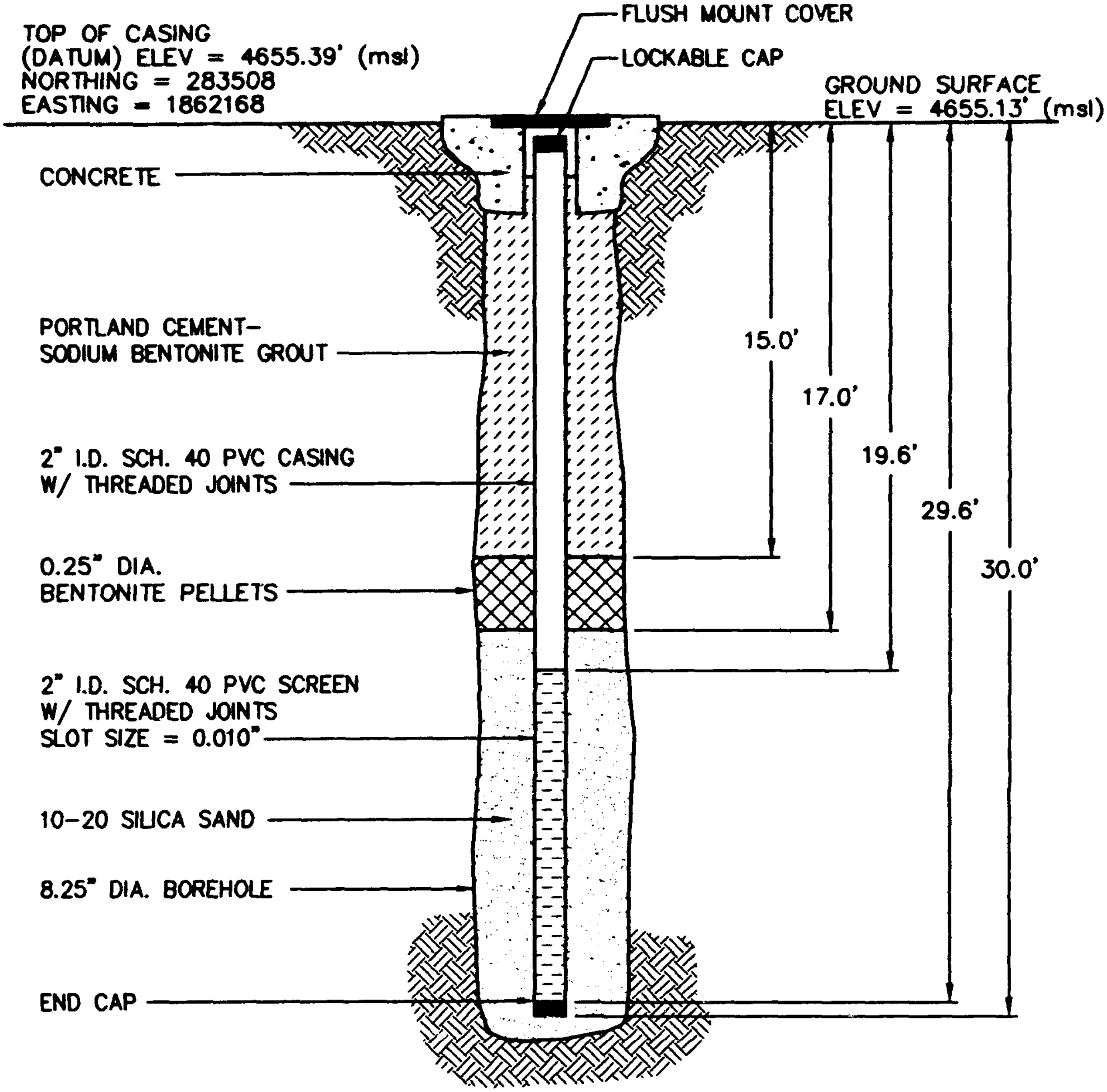

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msl MEAN SEA LEVEL

INSTALLATION DATE: 8/21/93

DRILLING CONTRACTOR: USEPA

GEOLOGIST: T.WIEDEMEIER, ES
J.BERNARD, ES

WELL COMPLETION DIAGRAM
MONITORING WELL: EPA-82D

Hill Air Force Base, Utah

ENGINEERING-SCIENCE, INC.

Denver, Colorado

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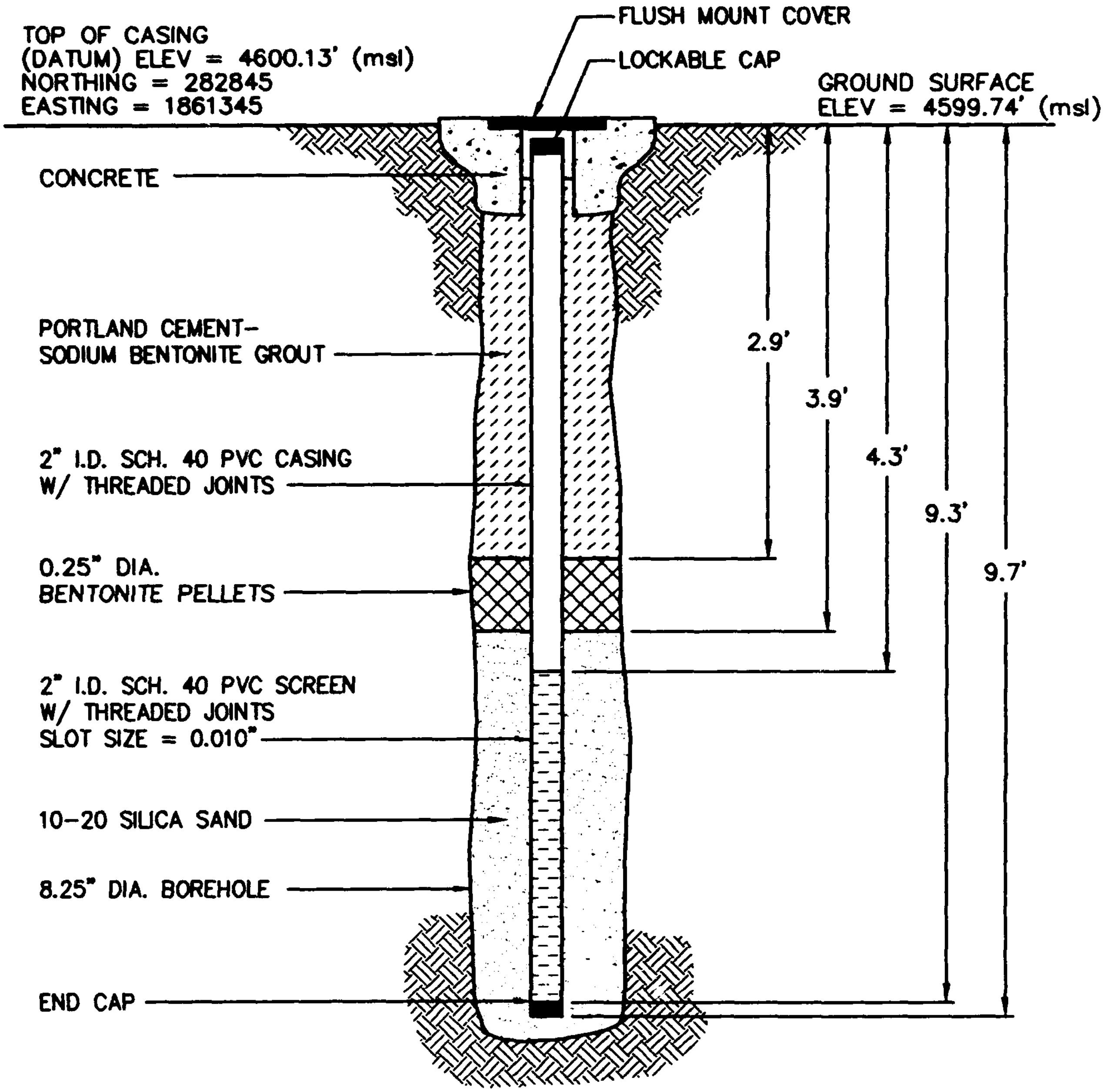

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LEGEND

msl MEAN SEA LEVEL

INSTALLATION DATE: 8/21/93

DRILLING CONTRACTOR: USEPA

GEOLOGIST: J.BERNARD, ES

WELL COMPLETION DIAGRAM
MONITORING WELL: EPA-82E

Hill Air Force Base, Utah

ENGINEERING-SCIENCE, INC.

Denver, Colorado

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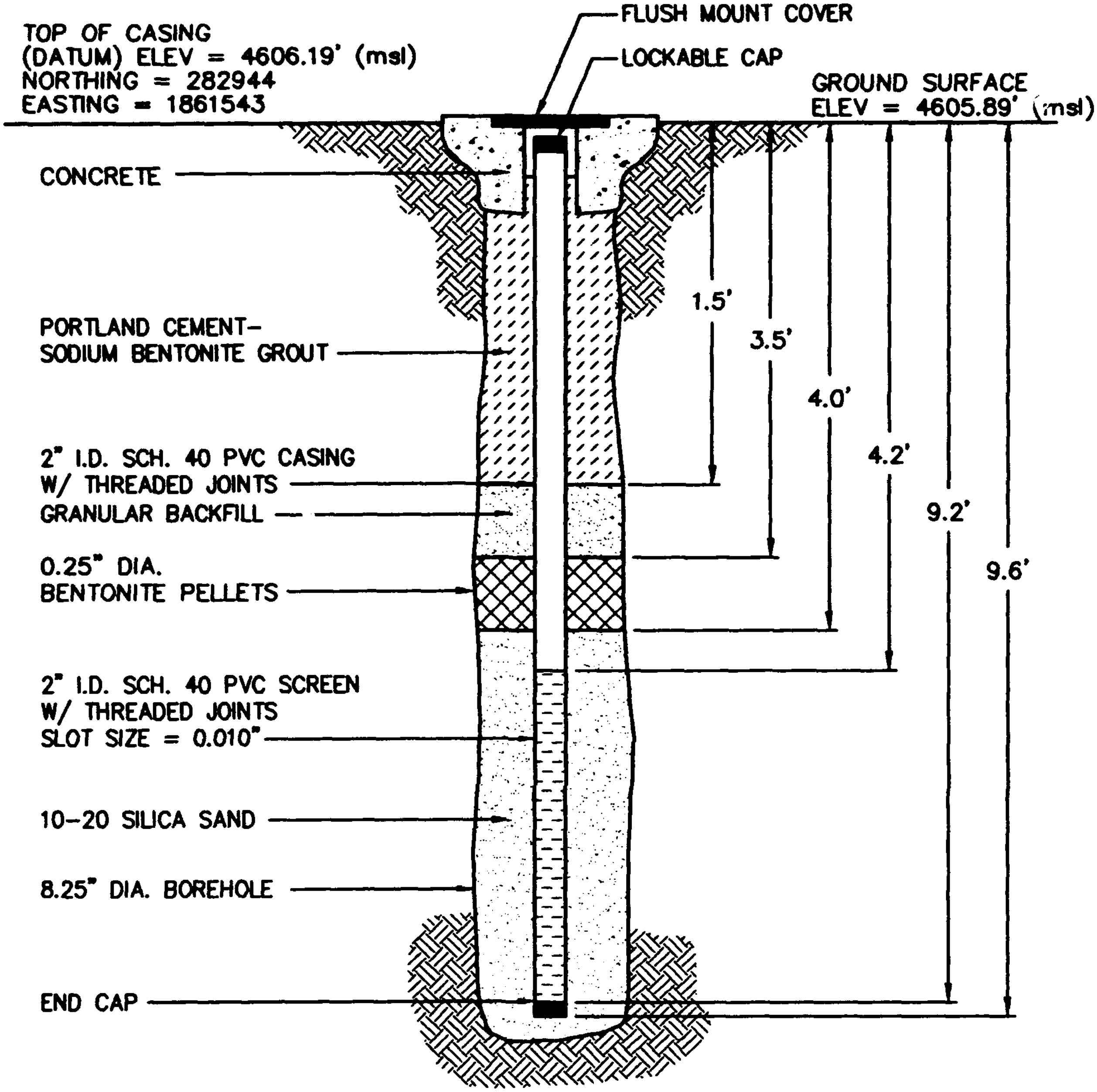

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LEGEND

msl MEAN SEA LEVEL

INSTALLATION DATE: 8/20/93

DRILLING CONTRACTOR: USEPA

GEOLOGIST: J.BERNARD, ES

WELL COMPLETION DIAGRAM
MONITORING WELL: EPA-82F

Hill Air Force Base, Utah

ENGINEERING-SCIENCE, INC.

Denver, Colorado

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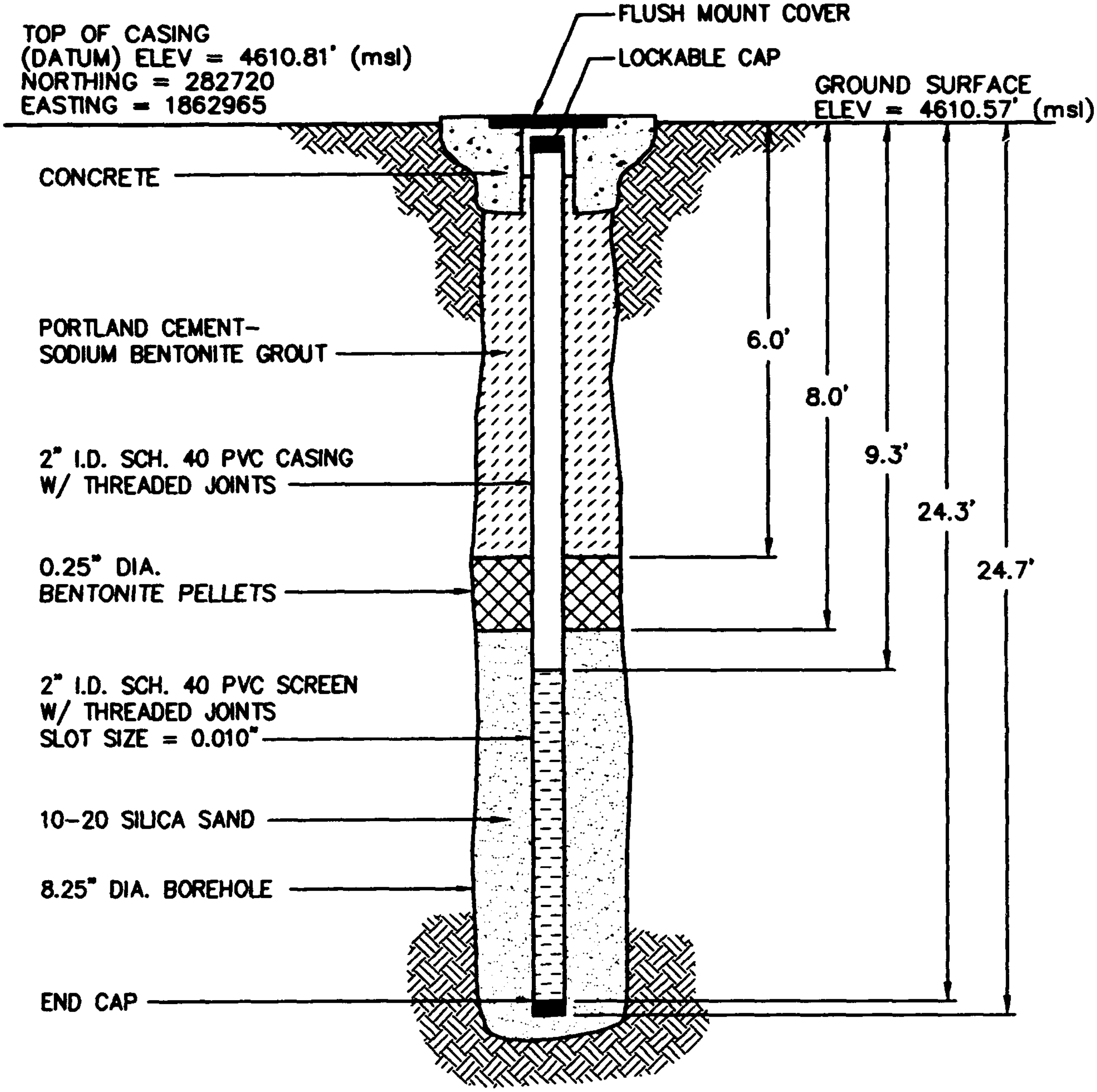

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LEGEND

msl MEAN SEA LEVEL

INSTALLATION DATE: 8/22/93

DRILLING CONTRACTOR: USEPA

GEOLOGIST: T.WIEDEMEIER, ES
J.BERNARD, ES

WELL COMPLETION DIAGRAM
MONITORING WELL: EPA-82H

Hill Air Force Base, Utah

ENGINEERING-SCIENCE, INC.

Denver, Colorado

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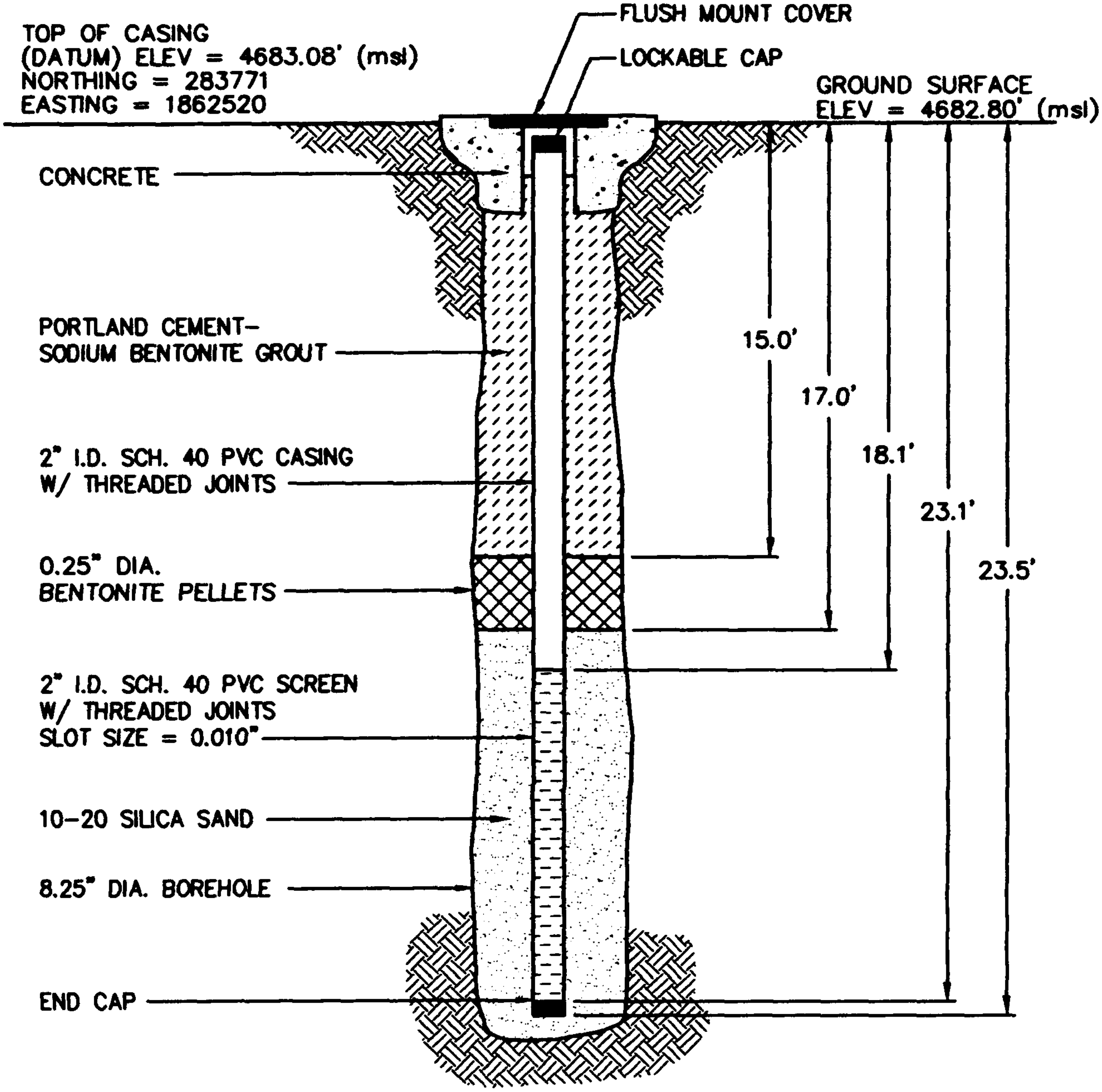

NOT TO SCALE

LEGEND

msl MEAN SEA LEVEL

INSTALLATION DATE: 8/22/93

DRILLING CONTRACTOR: USEPA

GEOLOGIST: T.WIEDEMEIER, ES

WELL COMPLETION DIAGRAM
MONITORING WELL: EPA-82I

Hill Air Force Base, Utah

ENGINEERING-SCIENCE, INC.

Denver, Colorado

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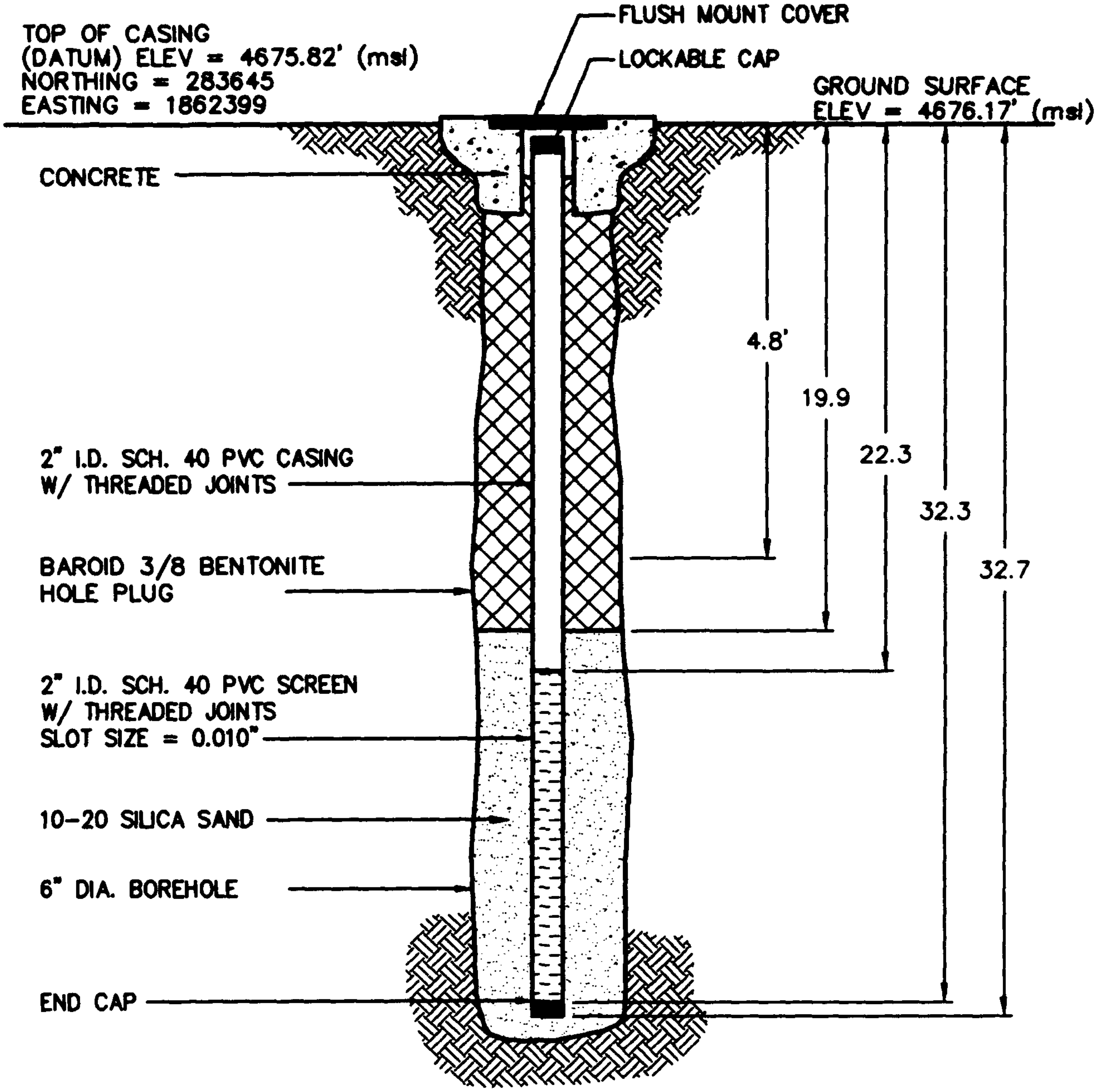

NOT TO SCALE

LEGEND

msl MEAN SEA LEVEL

INSTALLATION DATE: 7/11/94

DRILLING CONTRACTOR: USEPA

GEOLOGIST: T.WIEDEMEIER, ES

WELL COMPLETION DIAGRAM
MONITORING WELL: EPA-82-J

Hill Air Force Base, Utah

ENGINEERING-SCIENCE, INC.

Denver, Colorado

M:\45002\DRAWINGS\WELL\94DN1040, 09/20/94 at 12:55

GEOLOGIC BORING LOG

BORING NO.:	EPA-82-A	CONTRACTOR:	USEPA	DATE SPUD:	8/17/93
CLIENT:	AFCEE	RIG TYPE:	CME-55	DATE CMPL.:	8/17/93
JOB NO.:	DE311.02/722450.02	DRLG METHOD:	HSA	ELEVATION:	GS=4606.01
LOCATION:	HILL AFB	BORING DIA.:	8.25"	TEMP:	74 deg. F
GEOLOGIST:	THW/JFB	DRLG FLUID:	NONE	WEATHER:	SUNNY

COMENTS: COMPLETED AS MONITORING WELL EPA-82-A, SCREENED FROM 25.3 TO 30.3 ft. bgs.

Elev (ft)	Depth (ft)	Pro-file	US CS	Geologic Description	Core No.	Core Depth (ft)	Sample Type	Penet Res	PID(ppm)	TLV(ppm)	TOTAL BTEX(ppm)	TPH (ppm)
	0–1			Asphalt to 0.5 ft. Well-sorted fine-grained sand Fill to 1.4 ft.			CONTINUOUS CORE	NOT MEASURED				
	1		SP						0			
	2				1							
	3		ML	Light-brown, clayey SILT, 25 to 35% clay, dry semi-cohesive to cohesive, low plasticity, becomes damp @ ~4 ft. bgs.								
	4				2				0			
	5											
	6		SP	Light rust-tan, fine-to medium-grained moderately well sorted SAND. Becomes saturated at approx. 7ft. No hydrocarbon odor								
	7				3				0			
	8											
	9					NS						
	10											
	11								0			
	12				4							
	13											
	14											
	15		ML	Light-brown, clayey SILT to silty CLAY with scattered 1/8" to 1" sand stringers, damp (probably saturated but low porosity) no hydrocarbon odor, cohesive								
	16				5				1.2			
	17											
	18										<0.01	
	19										<0.01	
	20										<0.01	
	21				6						<0.01	
	22										<0.01	
	23		SM	Rusty-brown poorly sorted SAND from 22.5 to 23.4ft.					>1000		<0.01	
	24		ML	Clayey SILT					56		<0.01	
	25				7						<0.01	
	26										<0.01	
	27		SM	Light grayish-brown, clayey and silty very poorly-sorted, fine-to very-fine grained SAND, saturated, no hydrocarbon odor					2		<0.01	
	28				8						<0.01	
	29		ML	29.5 to 33.5 interbedded clay, silt and sand, dominated by tan to light rusty gray SILT, no hydrocarbon odor. Rusty-brown SAND Interbedded from 30.3 to 31.4 ft.					8		<0.01	
	30		SM								<0.01	
	31								9		<0.01	
	32		ML		9						<0.01	
	33										<0.01	
	34		CL	Gray, high plasticity CLAY, no odor							<0.01	
	35			TD @ 35.4 ft.							<0.01	

NOTES

bgs – Below Ground Surface
GS – Ground Surface
TOC – Top of Casing
NS – Not Sampled
SAA – Same As Above

SAMPLE TYPE

D – DRIVE
C – CORE
G – GRAB

GEOLOGIC BORING LOG

Sheet 1 of 1

BORING NO.:	EPA-82-B	CONTRACTOR:	USEPA	DATE SPUD:	8/18/93
CLIENT:	AFCEE	RIG TYPE:	CME-55	DATE CMPL.:	8/18/93
JOB NO.:	DE311.02/722450.02	DRLG METHOD:	HSA	ELEVATION:	GS=4632.99
LOCATION:	HILL AFB	BORING DIA.:	8.25"	TEMP:	85 deg. F
GEOLOGIST:	THW/JFB	DRLG FLUID:	NONE	WEATHER:	SUNNY

COMENTS: COMPLETED AS MONITORING WELL EPA-82-B, SCREENED FROM 20.3 TO 30.3 ft. bgs

Elev (ft)	Depth (ft)	Pro-file	US CS	Geologic Description	Core No.	Core Depth (ft)	Sample Type	Penet Res	PID(ppm)	TLV(ppm)	TOTAL BTEX(ppm)	TPH (ppm)
	0–1			Asphalt to 0.5 ft.	1		CONTINUOUS CORE	NOT MEASURED				
	1–3		ML to CL	Light reddish-brown, silty CLAY with laminations of silt.								
	3–4			Slightly damp, no hydrocarbon odor					2			
4627.99	5				2							
	6–7		SP						2			
	8–9			Tan to reddish-brown, fine-to medium-grained moderately sorted SAND, no odor, damp								
	9–10								2			
4622.99	10				3							
4617.99	15				4							
	15–16								2			
	19–20			...no odor					2			
4612.99	20				5							
	20–21			...becomes medium grained							<0.01	
	21–22										<0.01	
	22–23										<0.01	
	23–24			...becomes medium-to coarse-grained							<0.01	
	24–25			...becomes saturated @ ≈ 25'	6						<0.01	
4607.99	25–26			...no odor					2		<0.01	
	26–27										<0.01	
	27–28		CL								<0.01	
	28–29					NS			2		<0.01	
4602.99	29–31			Sharp contact light reddish-brown silty CLAY, cohesive								
	32–35			TD @ 32 feet								

NOTES

bgs – Below Ground Surface

GS – Ground Surface

TOC – Top of Casing

NS – Not Sampled

SAA – Same As Above

SAMPLE TYPE

D – DRIVE

C – CORE

G – GRAB

GEOLOGIC BORING LOG

BORING NO.:	EPA-82-C	CONTRACTOR:	USEPA	DATE SPUD:	8/18/93
CLIENT:	AFCEE	RIG TYPE:	CME-55	DATE CMPL.:	8/18/93
JOB NO.:	DE311.02/722450.02	DRLG METHOD:	HSA	ELEVATION:	GS=4624.92
LOCATION:	HILL AFB	BORING DIA.:	8.25"	TEMP:	90 deg.F
GEOLOGIST:	THW/JFB	DRLG FLUID:	NONE	WEATHER:	SUN TO PARTLY CLDY

COMENTS: COMPLETED AS MONITORING WELL EPA-82-C, SCREENED FROM 19.6 TO 24.6 ft. bgs

Elev (ft)	Depth (ft)	US CS	Geologic Description	Core No.	Sample Type	Penet Res	PID(ppm)	TLV(ppm)	TOTAL BTEX(ppm)	TPH (ppm)
	1		Asphalt to 0.5 ft. bgs		CONTINUOUS CORE	NOT MEASURED	0			
		SP	Gravelly SAND fill				0			
							0			
		ML	Hard, dark gray clayey SILT	1			0			
4619.92	5						0			
		SM	Light brown, very poorly sorted fine-to very-fine-grained clayey (25%) and silty (20%), SAND, damp				6			
							26			
							31			
				2			21			
4614.92	10	ML	Light brown, clayey SILT, damp				11			
							11			
							14			
				3			3			
							1			
4609.92	15						NS			
			light reddish-brown fine-to medium-grained moderately sorted SAND, damp,				1			
		SP	no odor				1			
				4			1			
			...becomes medium-to coarse-grained				NS			
4604.92	20		...strong hydrocarbon odor, black				NS			
			hydrocarbon staining				26		0.079	<10
			...becomes saturated				297		0.055	<10
			Light reddish-brown, silty CLAY, cohesive,	5			314		0.113	387
		ML	damp (probably saturated but low porosity)				12		<0.01	<10
			TD @ 24.0'							
4599.95	25									
4594.92	30									
	35									

NOTES

- bgs – Below Ground Surface
- GS – Ground Surface
- TOC – Top of Casing
- NS – Not Sampled
- SAA – Same As Above

SAMPLE TYPE

- D – DRIVE
- C – CORE
- G – GRAB

M:94DN0619, 07/08/94 at 14:55

GEOLOGIC BORING LOG

BORING NO.:	EPA-82-D	CONTRACTOR:	USEPA	DATE SPUD:	8/18/93
CLIENT:	AFCEE	RIG TYPE:	CME-55	DATE CMPL.:	8/18/93
JOB NO.:	DE311.02/722450.02	DRLG METHOD:	HSA	ELEVATION:	GS=4655.13
LOCATION:	HILL AFB	BORING DIA.:	8.25"	TEMP:	90 deg. F
GEOLOGIST:	THW/JFB	DRLG FLUID:	NONE	WEATHER:	PARTLY CLOUDY

COMENTS: COMPLETED AS MONITORING WELL EPA-82-D, SCREENED FROM 19.6 TO 29.6 ft. bgs

Elev (ft)	Depth (ft)	USCS	Geologic Description	Core No.	Sample Type	Penet Res	PID (ppm)	TLV (ppm)	TOTAL BTEX (ppm)	TPH (ppm)
		SP	Asphalt to 0.5 ft, Well Sorted Fine Sand Fill to 1.4 ft		CONTINUOUS CORE	NOT MEASURED	0			
	1						0			
			Brown, clayey and sandy SILT, interbedded thin red clay layers and thin poorly sorted very-fine-grained sand layers	1			0			
							0			
							0			
4650.13	5						0			
							0			
		ML		2			0			
							0			
							0			
4645.13	10						0			
							0			
				3			0			
							0			
							0			
4640.13	15						0			
			Reddish-brown, poorly to moderately sorted, fine- to medium-grained SAND, no hydrocarbon odor, damp				0			
				4			0			
		SP					0			
				NS			NS			
4635.13	20		...Black hydrocarbon staining, moderate petroleum hydrocarbon odor				1		<0.01	<10
							1		<0.023	<10
			...becomes saturated	5			199		0.635	<10
			Reddish-brown, clayey SILT to silty CLAY, saturated. Contains scattered interbeds of clay and very fine-grained sand						3.022	<10
4630.13	25						282		0.087	
				6			29		0.237	<10
		ML					25		0.244	
							27		0.270	
							20			
4625.13	30			7			42			
							33			
							11			
			TD @ 32 ft							
	35									

NOTES

bgs – Below Ground Surface
GS – Ground Surface
TOC – Top of Casing
NS – Not Sampled
SAA – Same As Above

SAMPLE TYPE

D – DRIVE
C – CORE
G – GRAB

M:94DN3620, 07/08/94 at 14:55

GEOLOGIC BORING LOG

BORING NO.:	EPA-82-E	CONTRACTOR:	USEPA	DATE SPUD:	8/21/93
CLIENT:	AFCEE	RIG TYPE:	CME-55	DATE CMPL.:	8/21/93
JOB NO.:	DE311.02/722450.02	DRLG METHOD:	HSA	ELEVATION:	GS=4599.74
LOCATION:	HILL AFB	BORING DIA.:	8.25"	TEMP:	72 deg. F
GEOLOGIST:	THW/JFB	DRLG FLUID:	NONE	WEATHER:	PARTLY CLOUDY

COMENTS: COMPLETED AS MONITORING WELL EPA-82-E, SCREENED FROM 4.3 TO 9.3 ft. bgs

Elev (ft)	Depth (ft)	Profile	USCS	Geologic Description	Core No.	Core Depth (ft)	Sample Type	Penet Res	PID (ppm)	TLV (ppm)	TOTAL BTEX (ppm)	TPH (ppm)
	1			Asphalt to 0.3 ft 0.3 to 2.0 ft sandy and gravelly FILL			CONTINUOUS CORE	NOT MEASURED	3			
			SP						1		<0.01	
				Light brown, moderately-sorted, fine-to medium-grained SAND, saturated, no odor	1				1		<0.01	
									1		<0.01	
4594.74	5								1		<0.01	
				...becomes coarse-grained					1		<0.01	
			ML		2				1		<0.01	
				Light-brown, clayey SILT to silty CLAY, cohesive, saturated, no odor					3		<0.01	
					3				2		<0.01	
4589.74	10								1		<0.01	
				TD @ 10.5 feet								
	15											
	20											
	25											
	30											
	35											

NOTES
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- NS – Not Sampled
- SAA – Same As Above

SAMPLE TYPE
- D – DRIVE
- C – CORE
- G – GRAB

GEOLOGIC BORING LOG

BORING NO.: EPA-82-F
CONTRACTOR: USEPA
DATE SPUD: 8/21/93
CLIENT: AFCEE
RIG TYPE: CME-55
DATE CMPL.: 8/21/93
JOB NO.: DE311.02/722450.02
DRLG METHOD: HSA
ELEVATION: GS=4605.89
LOCATION: HILL AFB
BORING DIA.: 8.25"
TEMP: 90 deg. F
GEOLOGIST: THW/JFB
DRLG FLUID: NONE
WEATHER: PARTLY CLOUDY
COMENTS: COMPLETED AS MONITORING WELL EPA-82-F, SCREENED FROM 4.2 TO 9.2 ft. bgs

Elev (ft)	Depth (ft)	Pro-file	US CS	Geologic Description	Core No.	Core Depth (ft)	Sample Type	Penet Res	PID(ppm)	TLV(ppm)	TOTAL BTEX(ppm)	TPH (ppm)
	1											
4600.89	5											
4595.89	10			See Boring Log EPA-82-A TD @ 10'								
	15											
	20											
	25											
	30											
	35											

NOTES
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SAMPLE TYPE
D – DRIVE
C – CORE
G – GRAB

GEOLOGIC BORING LOG

BORING NO.:	EPA-82-H	CONTRACTOR:	USEPA	DATE SPUD:	8/21/93
CLIENT:	AFCEE	RIG TYPE:	CME-55	DATE CMPL.:	8/21/93
JOB NO.:	DE311.02/722450.02	DRLG METHOD:	HSA	ELEVATION:	GS=4610.57
LOCATION:	HILL AFB	BORING DIA.:	8.25"	TEMP:	74 deg. F
GEOLOGIST:	THW/JFB	DRLG FLUID:	NONE	WEATHER:	SUNNY

COMENTS: COMPLETED AS MONITORING WELL EPA-82-H, SCREENED FROM 9.3 TO 24.3 ft. bgs

Elev (ft)	Depth (ft)	Pro-file	US CS	Geologic Description	Core No.	Core Depth (ft)	Sample Type	Penet Res	PID (ppm)	TLV (ppm)	TOTAL BTEX (ppm)	TPH (ppm)
	1			Asphalt to 0.6 ft								
			SP	FILL to 2.5 ft	1							
4605.57	5		ML	Light-brown, dry, crumbly silty clay. No odor present			CONTINUOUS CORE	NOT MEASURED				
4600.57	10		SP	Light reddish-brown, moderately-sorted, fine-to medium-grained SAND, damp, no hydrocarbon odor ...becomes saturated	2							
4595.57	15		SP		3							
					4							
4590.57	20			...becomes coarse-grained	5							
4585.57	25				6							
				Interbedded, light reddish-brown interbedded clay, silt, and sand								
4580.57	30				7							
				TD @ 31 feet								
	35											

NOTES

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NS – Not Sampled
SAA – Same As Above

SAMPLE TYPE

D – DRIVE
C – CORE
G – GRAB

M:94DN0623, 07/08/94 at 11:35

GEOLOGIC BORING LOG

BORING NO.:	EPA-82-I	CONTRACTOR:	USEPA	DATE SPUD:	8/22/93
CLIENT:	AFCEE	RIG TYPE:	CME-55	DATE CMPL.:	8/22/93
JOB NO.:	DE311.02/722450.02	DRLG METHOD:	HSA	ELEVATION:	GS=4682.80
LOCATION:	HILL AFB	BORING DIA.:	8.25"	TEMP:	82 deg. F
GEOLOGIST:	THW/JFB	DRLG FLUID:	NONE	WEATHER:	SUNNY

COMENTS: COMPLETED AS MONITORING WELL EPA-82-I, SCREENED FROM 18.1 TO 23.1 ft. bgs

Elev (ft)	Depth (ft)	US CS	Geologic Description	Core No.	Sample Type	Penet Res	PID(ppm)	TLV(ppm)	TOTAL BTEX(ppm)	TPH (ppm)
	1		Clayey and gravelly SAND fill to 2.0 ft		CONTINUOUS CORE	NOT MEASURED	NS			
							0			
				1			90			
							1			
4677.80	5	ML	Light reddish-brown sandy silt, damp, weak hydrocarbon odor				1			
							1			
							1			
				2			31			
							2			
4672.80	10		Light reddish-brown, poorly sorted, medium to coarse-grained SAND, damp, weak hydrocarbon odor				3			
							2			
				3			3			
							2			
							3		0.005	
4667.80	15	SP					3			138
							4		0.004	3530
			Free-and residual-phase contamination begins at 16.3 feet. Dark hydrocarbon discoloration. Strong odor at 17.0 feet	4			81		105.4	11500
							257		119.4	28300
							150		551.3	6080
4662.80	20		...becomes saturated @ ≈ 18'				397		14	<10
							176		7.37	276
				5			103		26.2	643
							357		20.2	340
			Light brown, clayey SILT to silty CLAY				239		16.1	<10
4657.80	25	ML					311		27.11	<10
				6			239		4.163	410
							252			<10
			TD @ 27 feet							
4652.80	30									
	35									

NOTES

bgs – Below Ground Surface
GS – Ground Surface
TOC – Top of Casing
NS – Not Sampled
SAA – Same As Above

SAMPLE TYPE

D – DRIVE
C – CORE
G – GRAB

GEOLOGIC BORING LOG

BORING NO.: EPA-82-J
CONTRACTOR: USEPA RSKERL
DATE SPUD: 7/9/94
CLIENT: AFCEE
RIG TYPE: GIDDINGS
DATE CMPL.: 7/11/94
JOB NO.: DE311.02/722450.02
DRLG METHOD: HSA
ELEVATION:
LOCATION: HILL AFB
BORING DIA.: G"
TEMP: 97 deg. F
GEOLOGIST: TODD WIEDEMEIER
DRLG FLUID: NONE
WEATHER: CLEAR & HOT
COMENTS: COMPLETED AS EPA-82J (MONITORING WELL)

Elev (ft)	Depth (ft)	Profile	USCS	Geologic Description	Core No.	Core Depth (ft)	Sample Type	Penet Res	PID (ppm)	TLV (ppm)	TOTAL BTEX (ppm)	TPH (ppm)
	1, 5, 10		ML	Dark reddish brown, very poorly sorted clay and silty. Very fine grained SAND to clayey & sandy silt. Damp. No hydrocaron odor	1, 2, 3	NS	CONTINUOUS CORE	NOT MEASURED				
			SP	Light reddish brown, moderately sorted, fine-grained SAND. Damp. No hydrocaron odor	4				0 0 0			
	15		ML	Clay-rich fine-grained sand @ 13.5-16.5'. No hydrocarbon odor. Damp.	5				0 0 0			
			SP	Lighter reddish brown to brown, moderately well sorted, fine- to medium-grained SAND. Damp. No hydrocarbon.					0 0 0		 <0.01 <0.01	
	20			... becomes medium grained.	6				0 0 0 0		<0.01 <0.01 <0.01 <0.01	
	25			... becomes saturated @ 25' bgs.	7				0 0			
			SP to SM	... becomes fine grained with minor clay & some silt, saturated.					2153 1897			
	30			... strong hydrocarbon odor.	8				1594 1555			
			CL	Sharp contact into brown, clayey SILT to silty CLAY. Cohesive. Faint hydrocaron odor. Saturated.					175			
	35			TD @32.3 feet	9							

NOTES
bgs – Below Ground Surface
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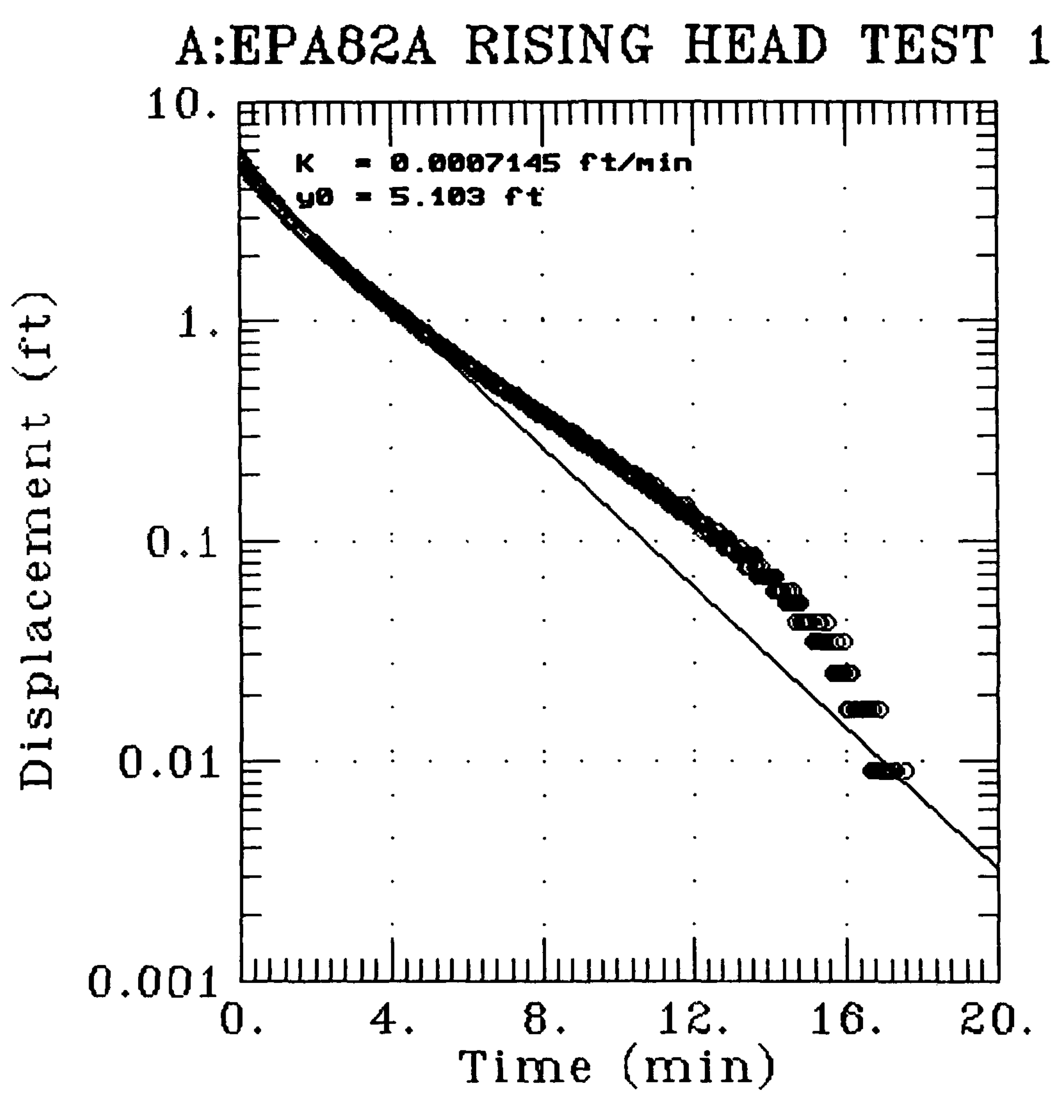
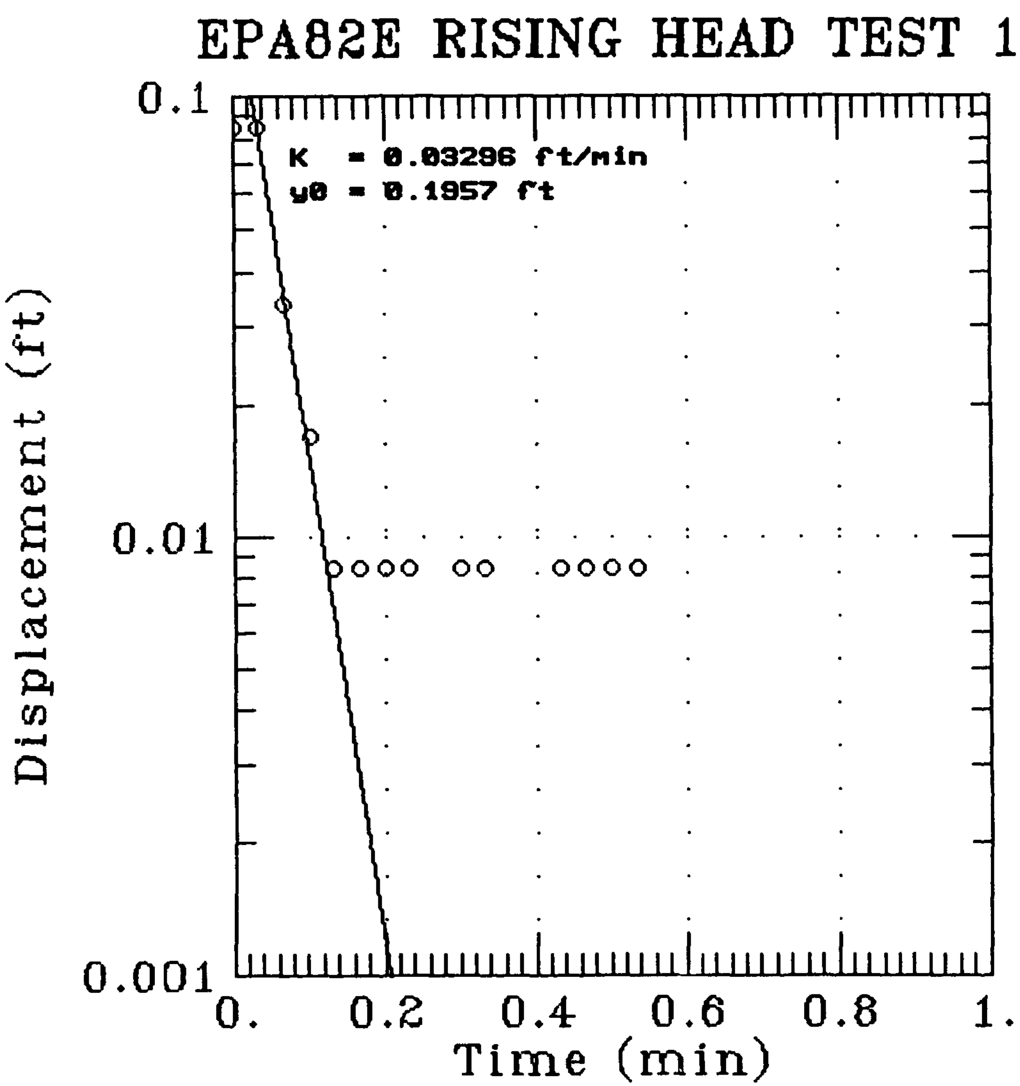
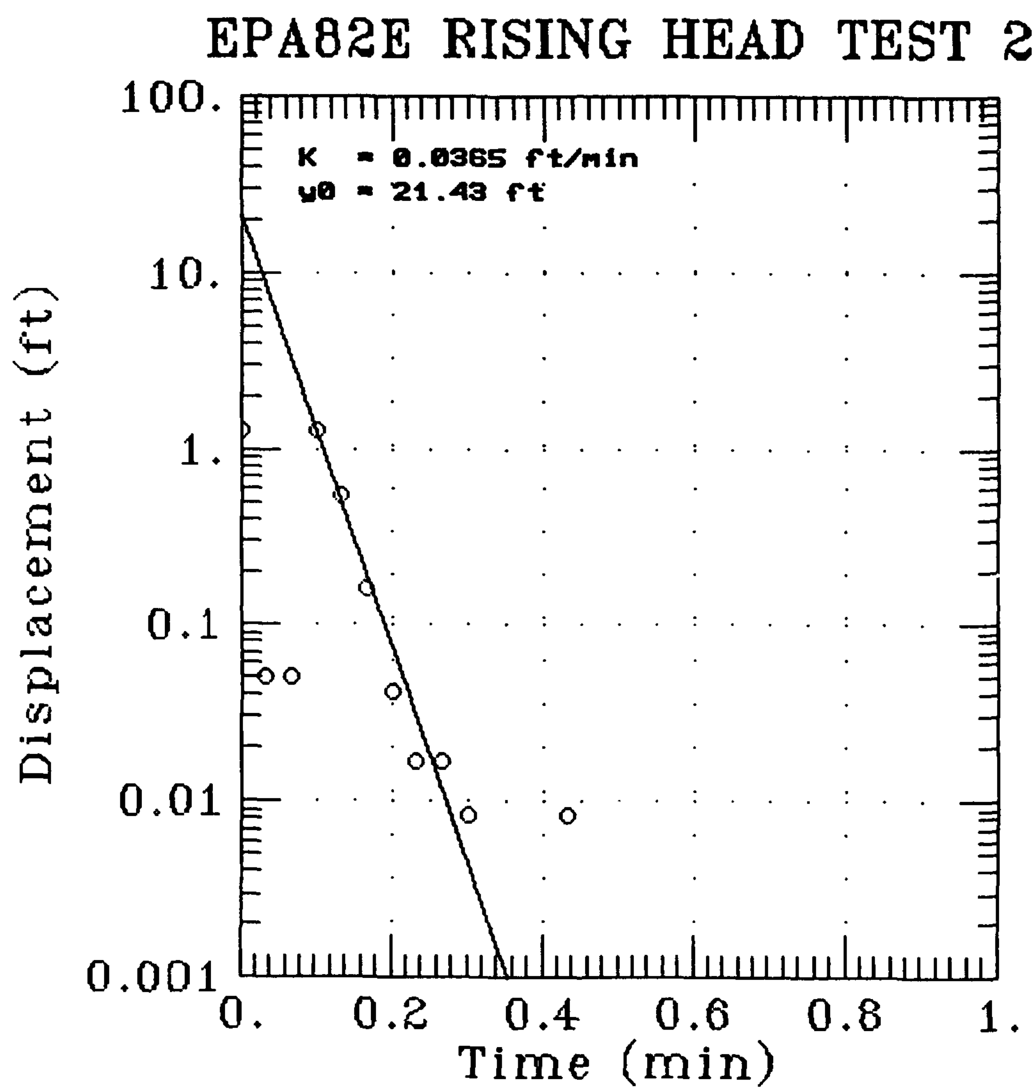
NS – Not Sampled
SAA – Same As Above

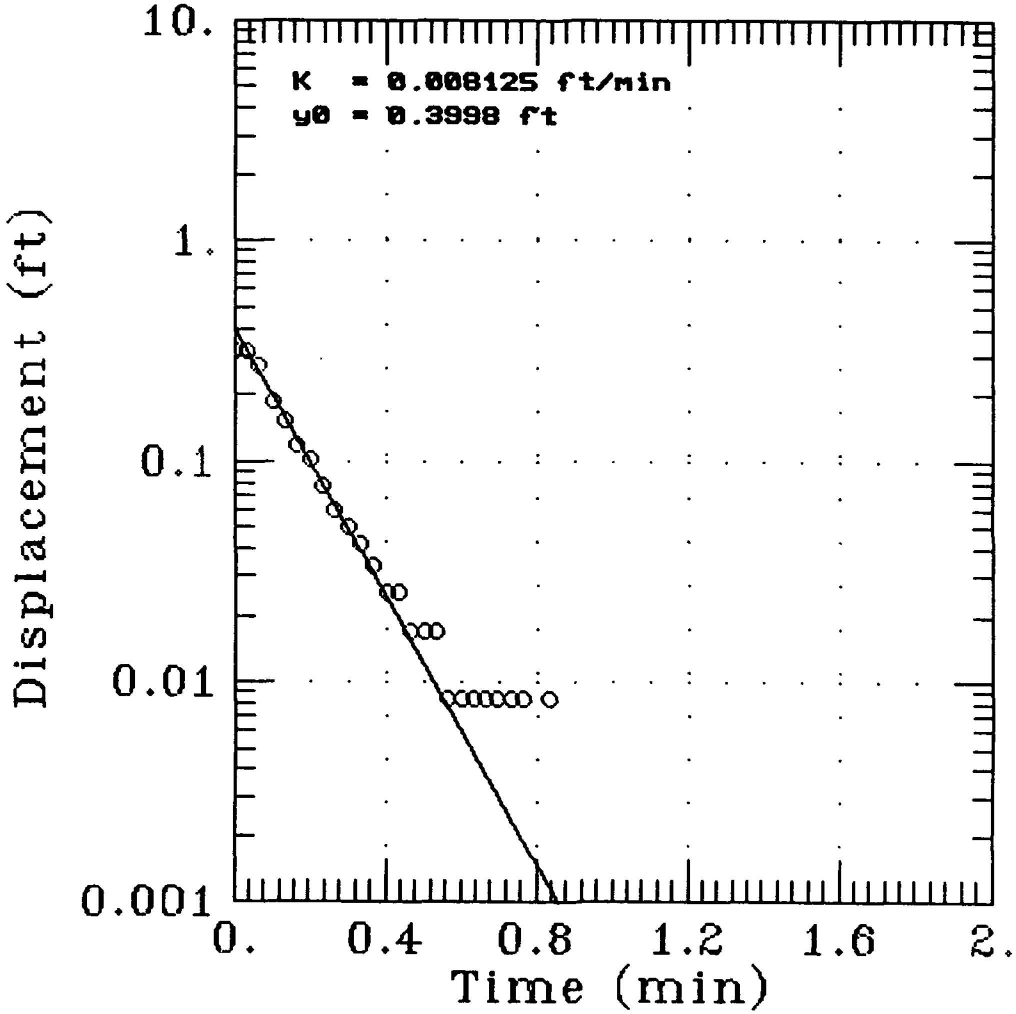
SAMPLE TYPE
D – DRIVE
C – CORE
G – GRAB


A:EPA82A RISING HEAD TEST 1
K = 0.0007145 ft/min
y0 = 5.103 ft
Displacement (ft)
10.
1.
0.1
0.01
0.001
0.
4.
8.
12.
16.
20.
Time (min)

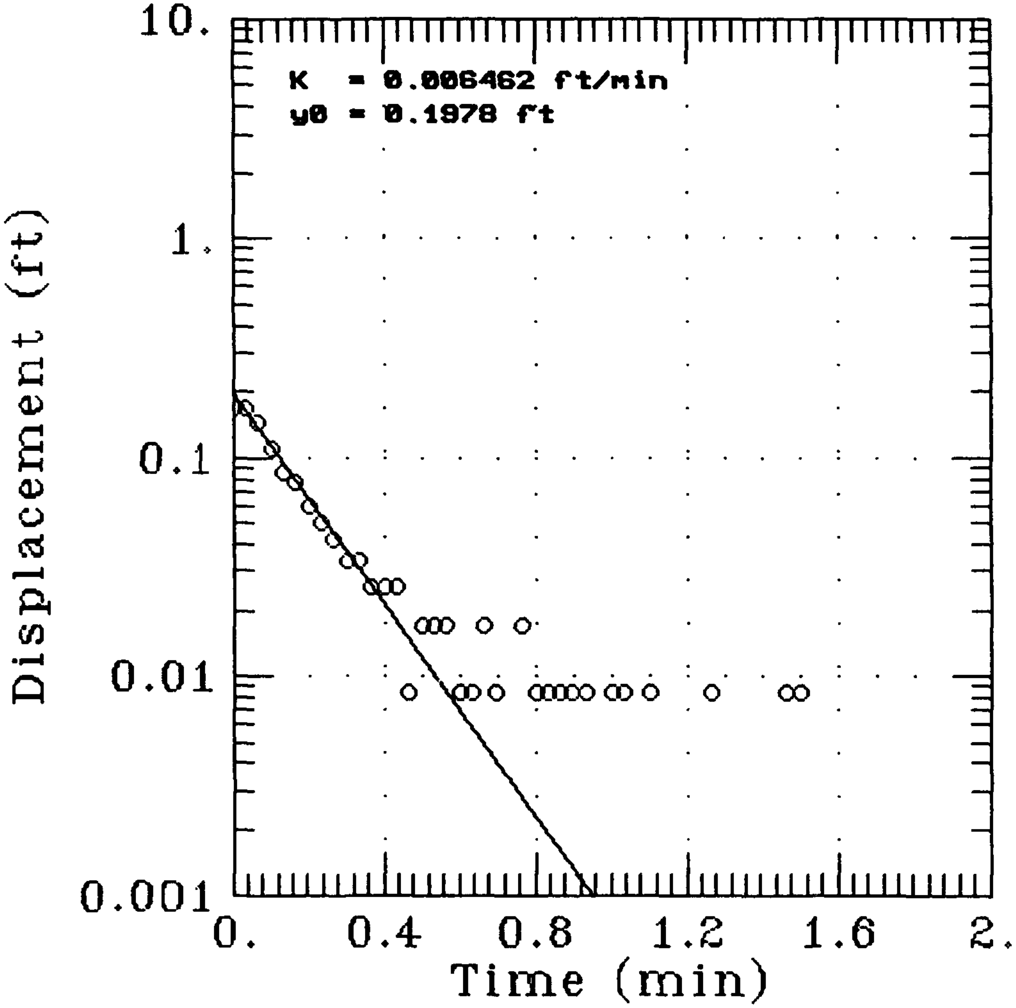

EPA82E RISING HEAD TEST 1
K = 0.03296 ft/min
y0 = 0.1957 ft
0.1
0.01
0.001
Displacement (ft)
0.
0.2
0.4
0.6
0.8
1.
Time (min)

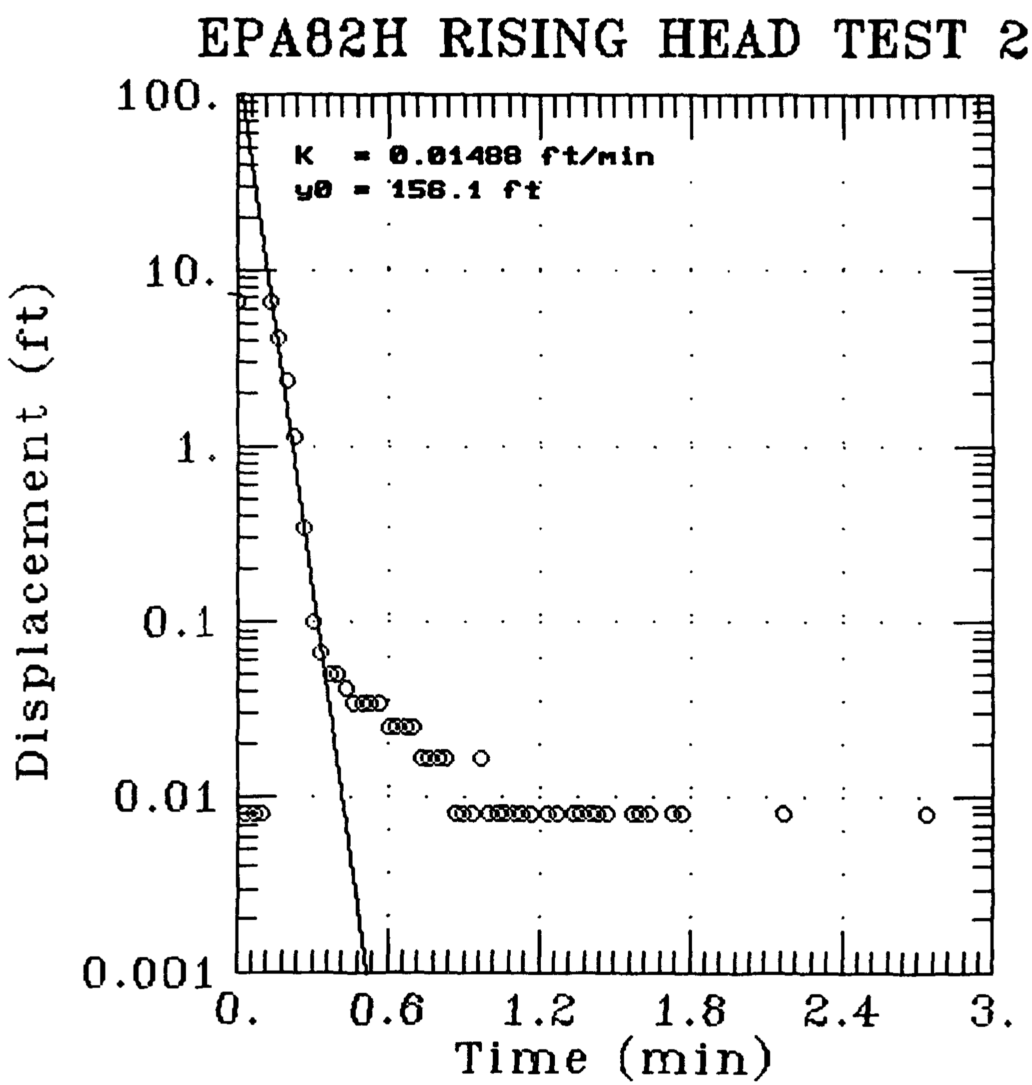

EPA82E RISING HEAD TEST 2
K = 0.0365 ft/min
y0 = 21.43 ft
Displacement (ft)
100.
10.
1.
0.1
0.01
0.001
0.
0.2
0.4
0.6
0.8
1.
Time (min)

EPA82F RISING HEAD TEST 1

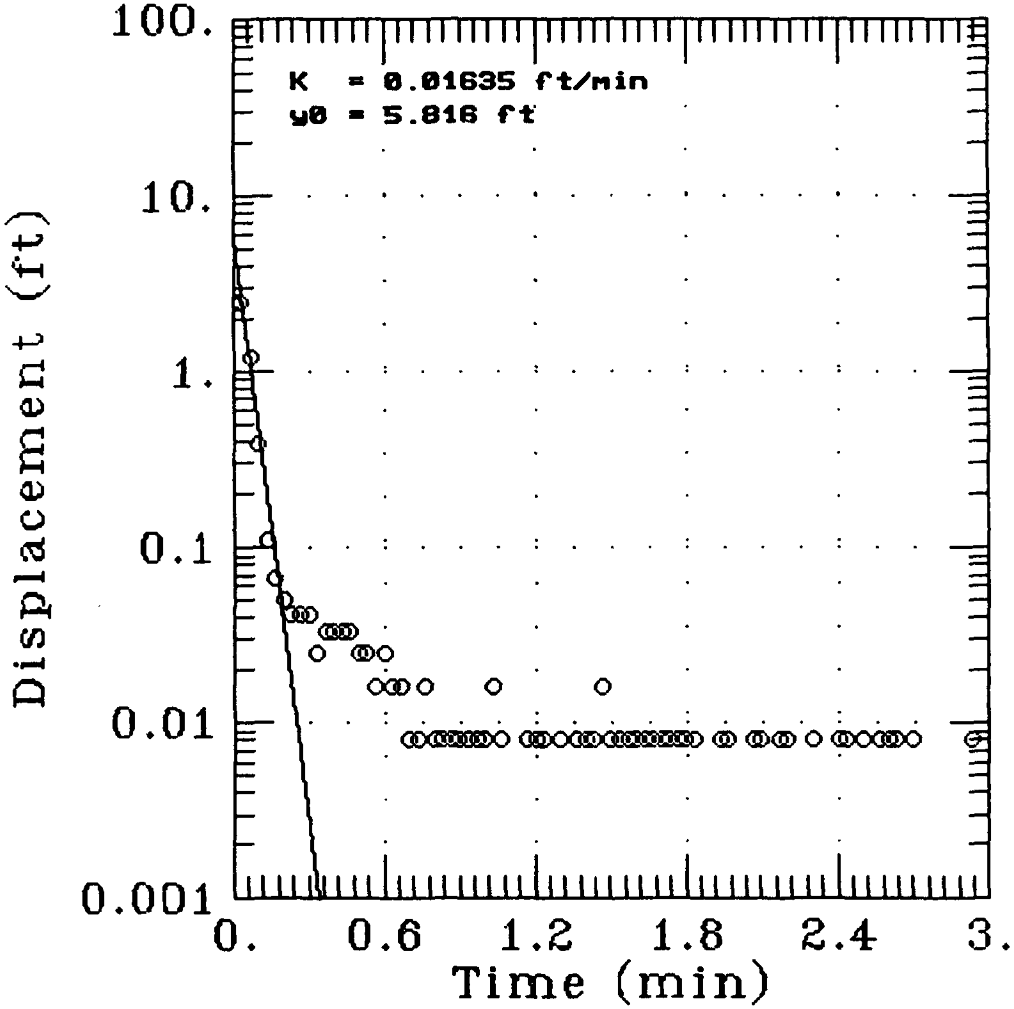


EPA82F RISING HEAD TEST 2

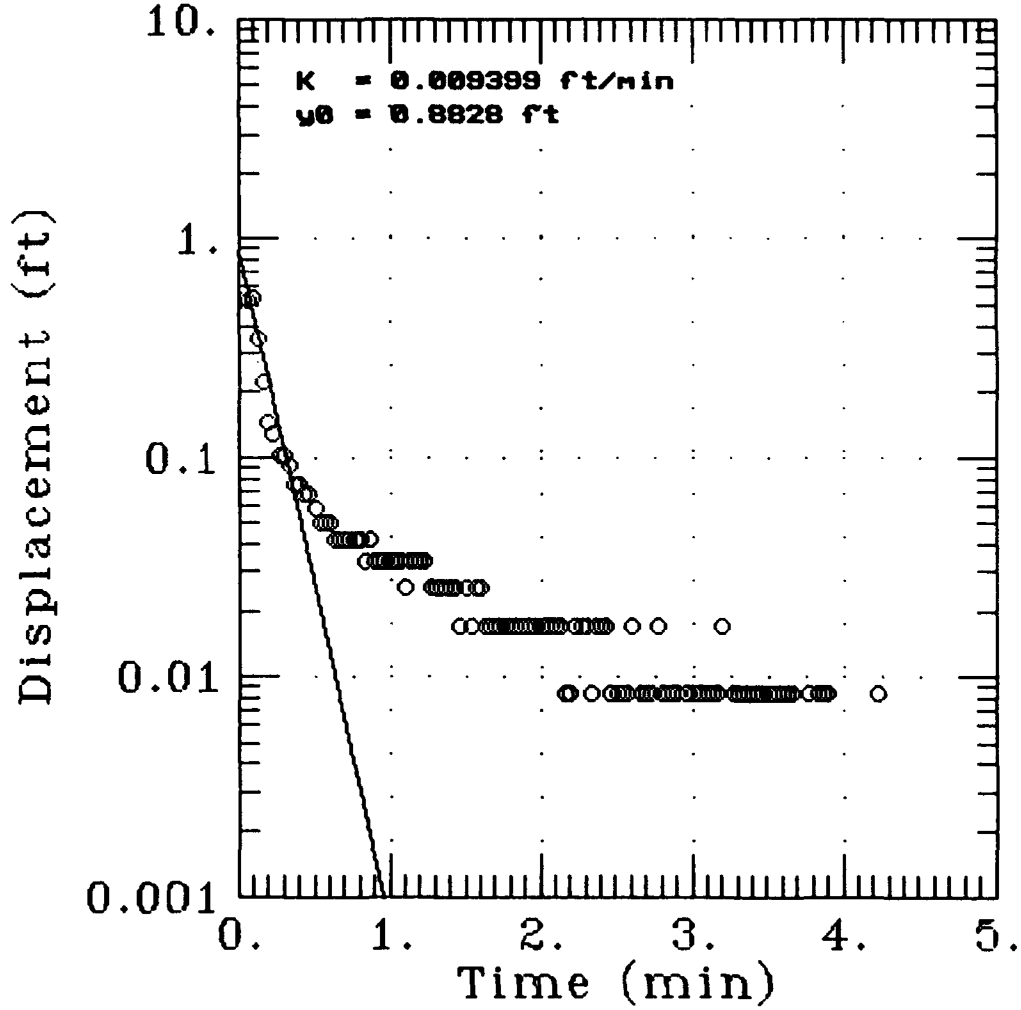



EPA82H RISING HEAD TEST 2
K = 0.01488 ft/min
y0 = 156.1 ft
Displacement (ft)
100.
10.
1.
0.1
0.01
0.001
Time (min)
0.
0.6
1.2
1.8
2.4
3.

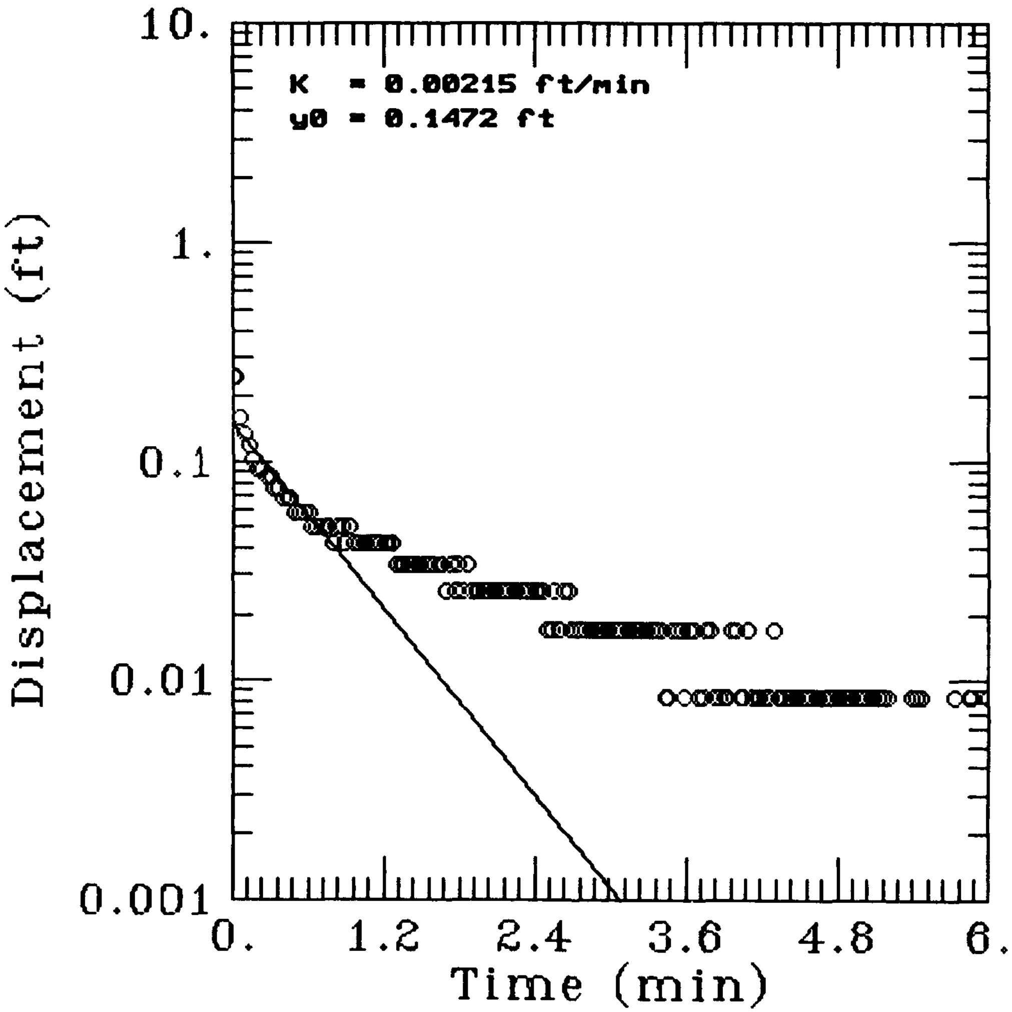
EPA82H RISING HEAD TEST 3



EPA82I RISING HEAD TEST 1



EPA82I RISING HEAD TEST 2



HILL AIR FORCE BASE SLUG TEST ANALYSES
DE311.02.02

PARAMETER	EPA82AR1	EPA82ER1	EPA82ER2	EPA82FR1	EPA82FR2	EPA82HR1	EPA82HR2	EPA82HR3	EPA82IR1	EPA82IR2
Int. displace.										
Casing radius	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833
Well radius	0.3438	0.3438	0.3438	0.3438	0.3438	0.3438	0.3438	0.3438	0.3438	0.3438
Sat. Thickness	25.55	4.4	4.4	3.17	3.17	13.35	13.35	13.35	4.7	4.7
Screen length	5	5	5	5	5	15	15	15	5	5
Height of water in well	25.55	4.4	4.4	3.17	3.17	13.35	13.35	13.35	4.7	4.7

APPENDIX B

GROUND WATER ELEVATION AND MOBILE LNAPL THICKNESS DATA
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

Sample Location	Sample Date	Easting	Northing	Datum Elevation (ft msl)	Measured Depth to Water (ft BTOC)	Depth to Product (ft BTOC)	Product Thickness (feet)	Corr. Depth to Water* (ft BTOC)	Corr. GW Elevation (ft msl)
CPT-2	12/28/93	SDNA	SDNA	SDNA	26.98	18.58	8.40	20.68	NA
	1/20/94	SDNA	SDNA	SDNA	26.50	20.82	5.68	22.24	NA
	2/3/94	SDNA	SDNA	SDNA	26.95	21.16	5.79	22.61	NA
	2/17/94	SDNA	SDNA	SDNA	26.83	21.23	5.60	22.63	NA
	3/3/94	SDNA	SDNA	SDNA	26.99	21.59	5.40	22.94	NA
	3/17/94	SDNA	SDNA	SDNA	26.78	21.55	5.23	22.86	NA
	3/31/94	SDNA	SDNA	SDNA	26.79	21.79	5.00	23.04	NA
	4/14/94	SDNA	SDNA	SDNA	26.80	21.78	5.02	23.04	NA
CPT-3	12/28/93	SDNA	SDNA	SDNA	21.41	-	0.00	21.41	NA
	1/20/94	SDNA	SDNA	SDNA	21.45	21.00	0.45	21.11	NA
	2/3/94	SDNA	SDNA	SDNA	21.34	21.19	0.15	21.23	NA
	2/17/94	SDNA	SDNA	SDNA	21.27	21.12	0.15	21.16	NA
	3/3/94	SDNA	SDNA	SDNA	21.72	21.71	0.01	21.71	NA
	3/17/94	SDNA	SDNA	SDNA	21.74	-	0.00	21.74	NA
	3/31/94	SDNA	SDNA	SDNA	21.80	-	0.00	21.80	NA
	4/14/94	SDNA	SDNA	SDNA	21.91	-	0.00	21.91	NA
CPT-4	12/28/93	SDNA	SDNA	SDNA	22.83	-	0.00	22.83	NA
	1/20/94	SDNA	SDNA	SDNA	22.97	-	0.00	22.97	NA
	2/3/94	SDNA	SDNA	SDNA	22.90	-	0.00	22.90	NA
	2/17/94	SDNA	SDNA	SDNA	22.83	-	0.00	22.83	NA
	3/3/94	SDNA	SDNA	SDNA	23.26	-	0.00	23.26	NA
	3/17/94	SDNA	SDNA	SDNA	23.26	-	0.00	23.26	NA
	3/31/94	SDNA	SDNA	SDNA	23.36	-	0.00	23.36	NA
	4/14/94	SDNA	SDNA	SDNA	23.51	-	0.00	23.51	NA
CPT-6	12/28/93	SDNA	SDNA	SDNA	20.58	-	0.00	20.58	NA
	1/20/94	SDNA	SDNA	SDNA	20.76	-	0.00	20.76	NA
	2/3/94	SDNA	SDNA	SDNA	20.87	-	0.00	20.87	NA
	3/3/94	SDNA	SDNA	SDNA	21.27	-	0.00	21.27	NA
	3/17/94	SDNA	SDNA	SDNA	21.00	-	0.00	21.00	NA
	3/31/94	SDNA	SDNA	SDNA	21.32	-	0.00	21.32	NA
	4/14/94	SDNA	SDNA	SDNA	21.21	-	0.00	21.21	NA
CPT-7	8/18/92	2547.88	3772.45	4684.21	21.69	-	0.00	21.69	4662.52
	4/21/93	2547.88	3772.45	4684.21	19.74	-	0.00	19.74	4664.47

APPENDIX B

GROUND WATER ELEVATION AND MOBILE LNAPL THICKNESS DATA
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

Sample Location	Sample Date	Easting	Northing	Datum Elevation (ft msl)	Measured Depth to Water (ft BTOC)	Depth to Product (ft BTOC)	Product Thickness (feet)	Corr. Depth to Water* (ft BTOC)	Corr. GW Elevation (ft msl)
	4/29/93	2547.88	3772.45	4684.21	19.45	-	0.00	19.45	4664.76
	5/6/93	2547.88	3772.45	4684.21	19.33	-	0.00	19.33	4664.88
	5/20/93	2547.88	3772.45	4684.21	18.69	-	0.00	18.69	4665.52
	6/17/93	2547.88	3772.45	4684.21	19.96	-	0.00	19.96	4664.25
	6/23/93	2547.88	3772.45	4684.21	20.00	17.10	2.90	17.83	4666.39
	7/1/93	2547.88	3772.45	4684.21	20.44	17.54	2.90	18.27	4665.95
	7/8/93	2547.88	3772.45	4684.21	20.51	16.51	4.00	17.51	4666.70
	1/20/94	2547.88	3772.45	4684.21	23.48	19.00	4.48	20.12	4664.09
	2/3/94	2547.88	3772.45	4684.21	23.85	19.70	4.15	20.74	4663.47
	2/17/94	2547.88	3772.45	4684.21	23.70	19.99	3.71	20.92	4663.29
	3/3/94	2547.88	3772.45	4684.21	23.85	19.90	3.95	20.89	4663.32
	3/17/94	2547.88	3772.45	4684.21	23.85	19.85	4.00	20.85	4663.36
	3/31/94	2547.88	3772.45	4684.21	23.45	19.45	4.00	20.45	4663.76
	4/14/94	2547.88	3772.45	4684.21	23.35	20.32	3.03	21.08	4663.13
CPT-9	1/20/94	SDNA	SDNA	SDNA	DRY	-	0.00	DRY	NA
	3/17/94	SDNA	SDNA	SDNA	DRY	-	0.00	DRY	NA
	3/31/94	SDNA	SDNA	SDNA	DRY	-	0.00	DRY	NA
CPT-10	8/18/92	2602.28	3772.04	4686.54	22.10	-	0.00	22.10	4664.44
	4/21/93	2602.28	3772.04	4686.54	19.50	-	0.00	19.50	4667.04
	4/29/93	2602.28	3772.04	4686.54	19.50	-	0.00	19.50	4667.04
	5/6/93	2602.28	3772.04	4686.54	19.35	-	0.00	19.35	4667.19
	5/20/93	2602.28	3772.04	4686.54	19.06	18.16	0.90	18.39	4668.16
	6/17/93	2602.28	3772.04	4686.54	19.10	-	0.00	19.10	4667.44
	6/23/93	2602.28	3772.04	4686.54	19.00	17.70	1.30	18.03	4668.52
	7/1/93	2602.28	3772.04	4686.54	18.94	17.34	1.60	17.74	4668.80
	7/8/93	2602.28	3772.04	4686.54	19.10	16.60	2.50	17.23	4669.32
	1/20/94	2602.28	3772.04	4686.54	21.43	18.35	3.08	19.12	4667.42
	2/3/94	2602.28	3772.04	4686.54	21.51	21.36	0.15	21.40	4665.14
	2/17/94	2602.28	3772.04	4686.54	21.48	21.31	0.17	21.35	4665.19
	3/3/94	2602.28	3772.04	4686.54	21.73	21.02	0.71	21.20	4665.34
	3/17/94	2602.28	3772.04	4686.54	21.58	21.00	0.58	21.15	4665.40
	3/31/94	2602.28	3772.04	4686.54	21.60	20.00	1.60	20.40	4666.14
	4/14/94	2602.28	3772.04	4686.54	21.50	16.50	5.00	17.75	4668.79

APPENDIX B

GROUND WATER ELEVATION AND MOBILE LNAPL THICKNESS DATA
UST SITE 870 INTRINSIC REMEDATION EE/CA
HILL AFB, UTAH

Sample Location	Sample Date	Easting	Northing	Datum Elevation (ft msl)	Measured Depth to Water (ft BTOC)	Depth to Product (ft BTOC)	Product Thickness (feet)	Corr. Depth to Water* (ft BTOC)	Corr. GW Elevation (ft msl)
CPT-11	12/28/93	SDNA	SDNA	SDNA	25.57	-	0.00	25.57	NA
	1/20/94	SDNA	SDNA	SDNA	25.82	-	0.00	25.82	NA
	2/3/94	SDNA	SDNA	SDNA	25.91	-	0.00	25.91	NA
	2/17/94	SDNA	SDNA	SDNA	27.94	-	0.00	27.94	NA
	3/3/94	SDNA	SDNA	SDNA	26.40	-	0.00	26.40	NA
	3/17/94	SDNA	SDNA	SDNA	26.47	-	0.00	26.47	NA
	3/31/94	SDNA	SDNA	SDNA	26.69	-	0.00	26.69	NA
	4/14/94	SDNA	SDNA	SDNA	27.00	-	0.00	27.00	NA
CPT-13	1/20/94	SDNA	SDNA	SDNA	DRY	-	0.00	DRY	NA
	3/17/94	SDNA	SDNA	SDNA	DRY	-	0.00	DRY	NA
	3/31/94	SDNA	SDNA	SDNA	DRY	-	0.00	DRY	NA
CPT-14	8/18/92	2182.60	3507.60	4655.88	25.38	-	0.00	25.38	4630.50
	3/4/93	2182.60	3507.60	4655.88	27.08	24.57	2.51	25.20	4630.68
	3/18/93	2182.60	3507.60	4655.88	27.16	24.66	2.50	25.29	4630.60
	4/2/93	2182.60	3507.60	4655.88	27.34	23.60	3.74	24.54	4631.35
	4/29/93	2182.60	3507.60	4655.88	27.32	23.32	4.00	24.32	4631.56
	5/6/93	2182.60	3507.60	4655.88	26.98	22.98	4.00	23.98	4631.90
	5/20/93	2182.60	3507.60	4655.88	26.72	23.22	3.50	24.10	4631.79
	6/17/93	2182.60	3507.60	4655.88	27.53	24.03	3.50	24.91	4630.98
	6/23/93	2182.60	3507.60	4655.88	26.00	23.00	3.00	23.75	4632.13
	7/1/93	2182.60	3507.60	4655.88	26.80	23.80	3.00	24.55	4631.33
	7/8/93	2182.60	3507.60	4655.88	25.35	22.85	2.50	23.48	4632.41
	8/23/93	2182.60	3507.60	4655.88	23.50	-	0.00	23.50	4632.38
	12/28/93	2182.60	3507.60	4655.88	24.88	23.00	1.88	23.47	4632.41
	1/20/94	2182.60	3507.60	4655.88	25.40	23.49	1.91	23.97	4631.91
	2/3/94	2182.60	3507.60	4655.88	25.64	23.64	2.00	24.14	4631.74
	2/17/94	2182.60	3507.60	4655.88	25.73	23.58	2.15	24.12	4631.76
	3/3/94	2182.60	3507.60	4655.88	25.66	23.86	1.80	24.31	4631.57
	3/17/94	2182.60	3507.60	4655.88	25.85	24.45	1.40	24.80	4631.08
	3/31/94	2182.60	3507.60	4655.88	25.37	24.87	0.50	25.00	46[illegible]89
	4/14/94	2182.60	3507.60	4655.88	26.07	24.27	1.80	24.72	[illegible]
CPT-15	8/18/92	2262.51	2985.53	4638.74	32.97	-	0.00	32.97	4605.[illegible]
	3/4/93	2262.51	2985.53	4638.74	33.85	-	0.00	33.85	4604.89

APPENDIX B

GROUND WATER ELEVATION AND MOBILE LNAPL THICKNESS DATA
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

Sample Location	Sample Date	Easting	Northing	Datum Elevation (ft msl)	Measured Depth to Water (ft BTOC)	Depth to Product (ft BTOC)	Product Thickness (feet)	Corr. Depth to Water* (ft BTOC)	Corr. GW Elevation (ft msl)
	4/2/93	2262.51	2985.53	4638.74	33.50	-	0.00	33.50	4605.24
	4/29/93	2262.51	2985.53	4638.74	32.67	-	0.00	32.67	4606.07
	5/6/93	2262.51	2985.53	4638.74	32.50	-	0.00	32.50	4606.24
	5/20/93	2262.51	2985.53	4638.74	32.18	-	0.00	32.18	4606.56
	6/17/93	2262.51	2985.53	4638.74	31.73	-	0.00	31.73	4607.01
	6/23/93	2262.51	2985.53	4638.74	31.66	-	0.00	31.66	4607.08
	7/1/93	2262.51	2985.53	4638.74	31.56	-	0.00	31.56	4607.18
	7/8/93	2262.51	2985.53	4638.74	31.45	-	0.00	31.45	4607.29
	1/20/94	2262.51	2985.53	4638.74	32.25	-	0.00	32.25	4606.49
	2/3/94	2262.51	2985.53	4638.74	32.55	-	0.00	32.55	4606.19
	2/17/94	2262.51	2985.53	4638.74	32.85	-	0.00	32.85	4605.89
	3/3/94	2262.51	2985.53	4638.74	33.05	-	0.00	33.05	4605.69
	3/17/94	2262.51	2985.53	4638.74	33.28	-	0.00	33.28	4605.46
	3/31/94	2262.51	2985.53	4638.74	33.44	-	0.00	33.44	4605.30
	4/14/94	2262.51	2985.53	4638.74	33.59	-	0.00	33.59	4605.15
CPT-17	8/18/92	1528.38	3493.12	4635.28	11.82	-	0.00	11.82	4623.46
	3/4/93	1528.38	3493.12	4635.28	11.48	-	0.00	11.48	4623.80
	4/29/93	1528.38	3493.12	4635.28	11.58	-	0.00	11.58	4623.70
	5/6/93	1528.38	3493.12	4635.28	11.72	-	0.00	11.72	4623.56
	5/20/93	1528.38	3493.12	4635.28	11.67	-	0.00	11.67	4623.61
CPT-18	8/18/92	1885.05	3457.77	4641.46	13.44	-	0.00	13.44	4628.02
	3/4/93	1885.05	3457.77	4641.46	12.38	-	0.00	12.38	4629.08
	3/18/93	1885.05	3457.77	4641.46	11.80	-	0.00	11.80	4629.66
	4/2/93	1885.05	3457.77	4641.46	11.65	-	0.00	11.65	4629.81
	4/29/93	1885.05	3457.77	4641.46	11.97	-	0.00	11.97	4629.49
	5/6/93	1885.05	3457.77	4641.46	12.10	-	0.00	12.10	4629.36
	5/20/93	1885.05	3457.77	4641.46	12.00	-	0.00	12.00	4629.46
	6/17/93	1885.05	3457.77	4641.46	12.20	-	0.00	12.20	4629.26
	6/23/93	1885.05	3457.77	4641.46	12.20	-	0.00	12.20	4629.26
	7/1/93	1885.05	3457.77	4641.46	12.55	-	0.00	12.55	4628.91
	7/8/93	1885.05	3457.77	4641.46	12.66	-	0.00	12.66	4628.80
	8/23/93	1885.05	3457.77	4641.46	12.05	-	0.00	12.05	4629.41
	12/28/93	1885.05	3457.77	4641.46	12.75	-	0.00	12.75	4628.71

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GROUND WATER ELEVATION AND MOBILE LNAPL THICKNESS DATA
UST SITE 870 INTRINSIC REMEDATION EE/CA
HILL AFB, UTAH

Sample Location	Sample Date	Easting	Northing	Datum Elevation (ft msl)	Measured Depth to Water (ft BTOC)	Depth to Product (ft BTOC)	Product Thickness (feet)	Corr. Depth to Water* (ft BTOC)	Corr. GW Elevation (ft msl)
	1/20/94	1885.05	3457.77	4641.46	13.11	-	0.00	13.11	4628.35
	2/3/94	1885.05	3457.77	4641.46	13.35	-	0.00	13.35	4628.11
	3/3/94	1885.05	3457.77	4641.46	13.72	-	0.00	13.72	4627.74
	3/17/94	1885.05	3457.77	4641.46	13.85	-	0.00	13.85	4627.61
	3/31/94	1885.05	3457.77	4641.46	12.88	-	0.00	12.88	4628.58
	4/14/94	1885.05	3457.77	4641.46	13.29	-	0.00	13.29	4628.17
CPT-19	8/18/92	1948.46	3215.91	4636.98	30.73	-	0.00	30.73	4606.25
	3/4/93	1948.46	3215.91	4636.98	30.52	-	0.00	30.52	4606.46
	4/2/93	1948.46	3215.91	4636.98	29.50	-	0.00	29.50	4607.48
	4/29/93	1948.46	3215.91	4636.98	28.95	-	0.00	28.95	4608.03
	5/6/93	1948.46	3215.91	4636.98	28.85	-	0.00	28.85	4608.13
	5/20/93	1948.46	3215.91	4636.98	28.67	-	0.00	28.67	4608.31
	6/17/93	1948.46	3215.91	4636.98	28.32	-	0.00	28.32	4608.66
	6/23/93	1948.46	3215.91	4636.98	28.29	-	0.00	28.29	4608.69
	7/1/93	1948.46	3215.91	4636.98	28.30	-	0.00	28.30	4608.68
	7/8/93	1948.46	3215.91	4636.98	28.28	-	0.00	28.28	4608.70
	8/23/93	1948.46	3215.91	4636.98	28.02	-	0.00	28.02	4608.96
	12/28/93	1948.46	3215.91	4636.98	28.74	-	0.00	28.74	4608.24
	1/20/94	1948.46	3215.91	4636.98	23.07	-	0.00	23.07	4613.91
	2/3/94	1948.46	3215.91	4636.98	29.31	-	0.00	29.31	4607.67
	2/17/94	1948.46	3215.91	4636.98	29.45	-	0.00	29.45	4607.53
	3/3/94	1948.46	3215.91	4636.98	29.70	-	0.00	29.70	4607.28
	3/17/94	1948.46	3215.91	4636.98	29.81	-	0.00	29.81	4607.17
	3/31/94	1948.46	3215.91	4636.98	30.86	-	0.00	30.86	4606.12
	4/14/94	1948.46	3215.91	4636.98	30.05	-	0.00	30.05	4606.93
CPT-20	8/18/92	1848.28	3037.59	4625.48	25.12	-	0.00	25.12	4600.36
	3/4/93	1848.28	3037.59	4625.48	25.19	-	0.00	25.19	4600.29
	3/18/93	1848.28	3037.59	4625.48	27.75	-	0.00	27.75	4597.73
	4/2/93	1848.28	3037.59	4625.48	24.22	-	0.00	24.22	4601.26
	4/29/93	1848.28	3037.59	4625.48	23.50	22.50	1.00	22.75	4602.73
	5/6/93	1848.28	3037.59	4625.48	23.47	-	0.00	23.47	4602.01
	5/20/93	1848.28	3037.59	4625.48	23.25	-	0.00	23.25	4602.23
	6/17/93	1848.28	3037.59	4625.48	22.89	-	0.00	22.89	4602.59

APPENDIX B

GROUND WATER ELEVATION AND MOBILE LNAPL THICKNESS DATA
UST SITE 870 INTRINSIC REMEDATION EE/CA
HILL AFB, UTAH

Sample Location	Sample Date	Easting	Northing	Datum Elevation (ft msl)	Measured Depth to Water (ft BTOC)	Depth to Product (ft BTOC)	Product Thickness (feet)	Corr. Depth to Water* (ft BTOC)	Corr. GW Elevation (ft msl)
	6/23/93	1848.28	3037.59	4625.48	22.86	-	0.00	22.86	4602.62
	7/1/93	1848.28	3037.59	4625.48	22.79	-	0.00	22.79	4602.69
	7/8/93	1848.28	3037.59	4625.48	22.76	-	0.00	22.76	4602.72
	8/23/93	1848.28	3037.59	4625.48	22.36	-	0.00	22.36	4603.12
	12/28/93	1848.28	3037.59	4625.48	23.42	-	0.00	23.42	4602.06
	1/20/94	1848.28	3037.59	4625.48	23.75	-	0.00	23.75	4601.73
	2/3/94	1848.28	3037.59	4625.48	23.98	23.97	0.01	23.97	4601.51
	2/17/94	1848.28	3037.59	4625.48	24.06	24.05	0.01	24.05	4601.43
	3/3/94	1848.28	3037.59	4625.48	24.34	24.31	0.03	24.32	4601.16
	3/17/94	1848.28	3037.59	4625.48	24.45	-	0.00	24.45	4601.03
	3/31/94	1848.28	3037.59	4625.48	24.59	-	0.00	24.59	4600.89
	4/14/94	1848.28	3037.59	4625.48	24.65	-	0.00	24.65	4600.83
CPT-21	8/18/92	2349.56	3244.25	4655.91	30.68	-	0.00	30.68	4625.23
	3/4/93	2349.56	3244.25	4655.91	32.88	-	0.00	32.88	4623.03
	3/18/93	2349.56	3244.25	4655.91	32.70	-	0.00	32.70	4623.21
	4/2/93	2349.56	3244.25	4655.91	32.00	-	0.00	32.00	4623.91
	5/6/93	2349.56	3244.25	4655.91	31.59	-	0.00	31.59	4624.32
	5/20/93	2349.56	3244.25	4655.91	31.44	-	0.00	31.44	4624.47
	6/23/93	2349.56	3244.25	4655.91	31.27	-	0.00	31.27	4624.64
	7/1/93	2349.56	3244.25	4655.91	31.16	-	0.00	31.16	4624.75
	7/8/93	2349.56	3244.25	4655.91	31.11	-	0.00	31.11	4624.80
	12/28/93	2349.56	3244.25	4655.91	31.93	-	0.00	31.93	4623.98
	1/20/94	2349.56	3244.25	4655.91	22.34	-	0.00	22.34	4633.57
	2/3/94	2349.56	3244.25	4655.91	32.48	-	0.00	32.48	4623.43
	2/17/94	2349.56	3244.25	4655.91	32.66	-	0.00	32.66	4623.25
	3/3/94	2349.56	3244.25	4655.91	32.42	-	0.00	32.42	4623.49
	3/17/94	2349.56	3244.25	4655.91	32.80	-	0.00	32.80	4623.11
	3/31/94	2349.56	3244.25	4655.91	32.85	-	0.00	32.85	4623.06
	4/14/94	2349.56	3244.25	4655.91	32.94	-	0.00	32.94	4622.97
CPT-23	8/18/92	2526.12	2835.21	4642.49	28.25	-	0.00	28.25	4614.24
	3/4/93	2526.12	2835.21	4642.49	27.08	-	0.00	27.08	4615.41
	4/2/93	2526.12	2835.21	4642.49	26.82	-	0.00	26.82	4615.67
	4/29/93	2526.12	2835.21	4642.49	26.31	-	0.00	26.31	4616.18

APPENDIX B

GROUND WATER ELEVATION AND MOBILE LNAPL THICKNESS DATA
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

Sample Location	Sample Date	Easting	Northing	Datum Elevation (ft msl)	Measured Depth to Water (ft BTOC)	Depth to Product (ft BTOC)	Product Thickness (feet)	Corr. Depth to Water* (ft BTOC)	Corr. GW Elevation (ft msl)
	5/6/93	2526.12	2835.21	4642.49	26.18	-	0.00	26.18	4616.31
	5/20/93	2526.12	2835.21	4642.49	25.75	-	0.00	25.75	4616.74
	6/17/93	2526.12	2835.21	4642.49	25.14	-	0.00	25.14	4617.35
	6/23/93	2526.12	2835.21	4642.49	25.05	-	0.00	25.05	4617.44
	7/1/93	2526.12	2835.21	4642.49	24.87	-	0.00	24.87	4617.62
	7/8/93	2526.12	2835.21	4642.49	24.84	-	0.00	24.84	4617.65
	8/23/93	2526.12	2835.21	4642.49	24.40	-	0.00	24.40	4618.09
	12/28/93	2526.12	2835.21	4642.49	24.97	-	0.00	24.97	4617.52
	1/20/94	2526.12	2835.21	4642.49	25.06	-	0.00	25.06	4617.43
	2/3/94	2526.12	2835.21	4642.49	25.07	-	0.00	25.07	4617.42
	2/17/94	2526.12	2835.21	4642.49	25.04	-	0.00	25.04	4617.45
	3/3/94	2526.12	2835.21	4642.49	25.33	-	0.00	25.33	4617.16
	3/17/94	2526.12	2835.21	4642.49	25.37	-	0.00	25.37	4617.12
	3/31/94	2526.12	2835.21	4642.49	25.53	-	0.00	25.53	4616.96
	4/14/94	2526.12	2835.21	4642.49	25.71	-	0.00	25.71	4616.78
CPT-25	12/28/93	SDNA	SDNA	SDNA	28.74	-	0.00	28.74	NA
	1/20/94	SDNA	SDNA	SDNA	28.57	-	0.00	28.57	NA
	2/3/94	SDNA	SDNA	SDNA	28.37	-	0.00	28.37	NA
	2/17/94	SDNA	SDNA	SDNA	28.15	-	0.00	28.15	NA
	3/3/94	SDNA	SDNA	SDNA	25.82	-	0.00	25.82	NA
	3/17/94	SDNA	SDNA	SDNA	28.45	-	0.00	28.45	NA
	3/31/94	SDNA	SDNA	SDNA	28.62	-	0.00	28.62	NA
	4/14/94	SDNA	SDNA	SDNA	28.60	-	0.00	28.60	NA
CPT-26	8/18/92	1208.02	2573.01	4591.94	12.35	-	0.00	12.35	4579.59
	1/20/94	1208.02	2573.01	4591.94	DRY	-	0.00	DRY	NA
	3/17/94	1208.02	2573.01	4591.94	DRY	-	0.00	DRY	NA
	3/31/94	1208.02	2573.01	4591.94	DRY	-	0.00	DRY	NA
CPT-27	8/18/92	1662.55	2660.73	4604.04	8.57	-	0.00	8.57	4595.47
	4/21/93	1662.55	2660.73	4604.04	8.28	-	0.00	8.28	4595.76
	4/29/93	1662.55	2660.73	4604.04	8.42	-	0.00	8.42	4595.62
	5/6/93	1662.55	2660.73	4604.04	8.35	-	0.00	8.35	4595.69
	5/20/93	1662.55	2660.73	4604.04	8.20	-	0.00	8.20	4595.84
	6/17/93	1662.55	2660.73	4604.04	7.85	-	0.00	7.85	4596.19

APPENDIX B

GROUND WATER ELEVATION AND MOBILE LNAPL THICKNESS DATA
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

Sample Location	Sample Date	Easting	Northing	Datum Elevation (ft msl)	Measured Depth to Water (ft BTOC)	Depth to Product (ft BTOC)	Product Thickness (feet)	Corr. Depth to Water* (ft BTOC)	Corr. GW Elevation (ft msl)
	6/23/93	1662.55	2660.73	4604.04	7.56	-	0.00	7.56	4596.48
	7/1/93	1662.55	2660.73	4604.04	7.80	-	0.00	7.80	4596.24
	7/8/93	1662.55	2660.73	4604.04	7.69	-	0.00	7.69	4596.35
	8/23/93	1662.55	2660.73	4604.04	7.00	-	0.00	7.00	4597.04
	12/28/93	1662.55	2660.73	4604.04	8.51	-	0.00	8.51	4595.53
	1/20/94	1662.55	2660.73	4604.04	8.90	-	0.00	8.90	4595.14
	2/3/94	1662.55	2660.73	4604.04	9.08	-	0.00	9.08	4594.96
	2/17/94	1662.55	2660.73	4604.04	9.12	-	0.00	9.12	4594.92
	3/3/94	1662.55	2660.73	4604.04	8.99	-	0.00	8.99	4595.05
	3/17/94	1662.55	2660.73	4604.04	9.15	-	0.00	9.15	4594.89
	3/31/94	1662.55	2660.73	4604.04	8.88	-	0.00	8.88	4595.16
	4/14/94	1662.55	2660.73	4604.04	8.92	-	0.00	8.92	4595.12
CPT-28	8/18/92	1538.79	2939.72	4605.62	6.43	-	0.00	6.43	4599.19
	3/4/93	1538.79	2939.72	4605.62	6.18	-	0.00	6.18	4599.44
	4/29/93	1538.79	2939.72	4605.62	5.62	-	0.00	5.62	4600.00
	5/6/93	1538.79	2939.72	4605.62	5.72	-	0.00	5.72	4599.90
	5/20/93	1538.79	2939.72	4605.62	5.97	-	0.00	5.97	4599.65
	6/17/93	1538.79	2939.72	4605.62	5.88	-	0.00	5.88	4599.74
	6/23/93	1538.79	2939.72	4605.62	6.96	-	0.00	6.96	4598.66
	7/1/93	1538.79	2939.72	4605.62	5.82	-	0.00	5.82	4599.80
	7/8/93	1538.79	2939.72	4605.62	6.19	-	0.00	6.19	4599.43
	8/23/93	1538.79	2939.72	4605.62	5.07	-	0.00	5.07	4600.55
	12/28/93	1538.79	2939.72	4605.62	DRY	-	0.00	DRY	NA
	1/20/94	1538.79	2939.72	4605.62	DRY	-	0.00	DRY	NA
	2/3/94	1538.79	2939.72	4605.62	DRY	-	0.00	DRY	NA
	2/17/94	1538.79	2939.72	4605.62	6.56	-	0.00	6.56	4599.06
	3/3/94	1538.79	2939.72	4605.62	7.39	-	0.00	7.39	4598.23
	3/17/94	1538.79	2939.72	4605.62	7.43	-	0.00	7.43	4598.19
	3/31/94	1538.79	2939.72	4605.62	6.60	-	0.00	6.60	4599.02
	4/14/94	1538.79	2939.72	4605.62	7.04	-	0.00	7.04	4598.58
CPT-29	8/18/92	1400.23	2863.23	4600.67	5.15	-	0.00	5.15	4595.52
CPT-30	8/18/92	1963.38	2711.28	4610.22	12.82	-	0.00	12.82	4597.40
	4/21/93	1963.38	2711.28	4610.22	12.05	-	0.00	12.05	4598.17

APPENDIX B

GROUND WATER ELEVATION AND MOBILE LNAPL THICKNESS DATA
UST SITE 870 INTRINSIC REMEDATION EE/CA
HILL AFB, UTAH

Sample Location	Sample Date	Easting	Northing	Datum Elevation (ft msl)	Measured Depth to Water (ft BTOC)	Depth to Product (ft BTOC)	Product Thickness (feet)	Corr. Depth to Water* (ft BTOC)	Corr. GW Elevation (ft msl)
	4/29/93	1963.38	2711.28	4610.22	12.16	-	0.00	12.16	4598.06
	5/6/93	1963.38	2711.28	4610.22	12.15	-	0.00	12.15	4598.07
	5/20/93	1963.38	2711.28	4610.22	11.90	-	0.00	11.90	4598.32
	6/17/93	1963.38	2711.28	4610.22	11.60	-	0.00	11.60	4598.62
	6/23/93	1963.38	2711.28	4610.22	11.54	-	0.00	11.54	4598.68
	7/1/93	1963.38	2711.28	4610.22	11.50	-	0.00	11.50	4598.72
	7/8/93	1963.38	2711.28	4610.22	11.46	-	0.00	11.46	4598.76
	8/23/93	1963.38	2711.28	4610.22	10.70	-	0.00	10.70	4599.52
	12/28/93	1963.38	2711.28	4610.22	12.17	-	0.00	12.17	4598.05
	1/20/94	1963.38	2711.28	4610.22	12.44	-	0.00	12.44	4597.78
	2/3/94	1963.38	2711.28	4610.22	12.59	-	0.00	12.59	4597.63
	2/17/94	1963.38	2711.28	4610.22	12.71	-	0.00	12.71	4597.51
	3/3/94	1963.38	2711.28	4610.22	12.73	-	0.00	12.73	4597.49
	3/17/94	1963.38	2711.28	4610.22	12.81	-	0.00	12.81	4597.41
	3/31/94	1963.38	2711.28	4610.22	12.85	-	0.00	12.85	4597.37
	4/14/94	1963.38	2711.28	4610.22	12.85	-	0.00	12.85	4597.37
CPT-31	8/18/92	1418.19	3205.92	4610.88	7.37	-	0.00	7.37	4603.51
	3/4/93	1418.19	3205.92	4610.88	5.60	-	0.00	5.60	4605.28
	4/29/93	1418.19	3205.92	4610.88	4.50	-	0.00	4.50	4606.38
	5/6/93	1418.19	3205.92	4610.88	4.74	-	0.00	4.74	4606.14
	5/20/93	1418.19	3205.92	4610.88	5.42	-	0.00	5.42	4605.46
	6/17/93	1418.19	3205.92	4610.88	5.58	-	0.00	5.58	4605.30
	6/23/93	1418.19	3205.92	4610.88	5.80	-	0.00	5.80	4605.08
	7/1/93	1418.19	3205.92	4610.88	7.01	-	0.00	7.01	4603.87
	7/8/93	1418.19	3205.92	4610.88	5.78	-	0.00	5.78	4605.10
	8/23/93	1418.19	3205.92	4610.88	6.05	-	0.00	6.05	4604.83
	12/28/93	1418.19	3205.92	4610.88	7.80	-	0.00	7.80	4603.08
	1/20/94	1418.19	3205.92	4610.88	7.98	-	0.00	7.98	4602.90
	2/3/94	1418.19	3205.92	4610.88	8.15	-	0.00	8.15	4602.73
	2/17/94	1418.19	3205.92	4610.88	8.37	-	0.00	8.37	4602.51
	3/3/94	1418.19	3205.92	4610.88	7.19	-	0.00	7.19	4603.69
	3/17/94	1418.19	3205.92	4610.88	7.31	-	0.00	7.31	4603.57
	3/31/94	1418.19	3205.92	4610.88	7.28	-	0.00	7.28	4603.60

APPENDIX B

GROUND WATER ELEVATION AND MOBILE LNAPL THICKNESS DATA
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

Sample Location	Sample Date	Easting	Northing	Datum Elevation (ft msl)	Measured Depth to Water (ft BTOC)	Depth to Product (ft BTOC)	Product Thickness (feet)	Corr. Depth to Water* (ft BTOC)	Corr. GW Elevation (ft msl)
	4/14/94	1418.19	3205.92	4610.88	7.28	-	0.00	7.28	4603.60
CPT-32	1/20/94	SDNA	SDNA	SDNA	DRY	-	0.00	DRY	NA
	3/17/94	SDNA	SDNA	SDNA	DRY	-	0.00	DRY	NA
	3/31/94	SDNA	SDNA	SDNA	DRY	-	0.00	DRY	NA
CPT-33	12/28/93	SDNA	SDNA	SDNA	18.05	-	0.00	18.05	NA
	1/20/94	SDNA	SDNA	SDNA	18.33	-	0.00	18.33	NA
	2/3/94	SDNA	SDNA	SDNA	18.29	-	0.00	18.29	NA
	2/17/94	SDNA	SDNA	SDNA	18.21	-	0.00	18.21	NA
	3/3/94	SDNA	SDNA	SDNA	18.85	-	0.00	18.85	NA
	3/17/94	SDNA	SDNA	SDNA	18.70	-	0.00	18.70	NA
	3/31/94	SDNA	SDNA	SDNA	18.97	-	0.00	18.97	NA
	4/14/94	SDNA	SDNA	SDNA	19.21	-	0.00	19.21	NA
CPT-34	12/28/93	SDNA	SDNA	SDNA	20.10	-	0.00	20.10	NA
	1/20/94	SDNA	SDNA	SDNA	20.27	-	0.00	20.27	NA
	2/3/94	SDNA	SDNA	SDNA	20.32	-	0.00	20.32	NA
	2/17/94	SDNA	SDNA	SDNA	20.32	-	0.00	20.32	NA
	3/3/94	SDNA	SDNA	SDNA	20.40	-	0.00	20.40	NA
	3/17/94	SDNA	SDNA	SDNA	20.45	-	0.00	20.45	NA
	3/31/94	SDNA	SDNA	SDNA	20.55	-	0.00	20.55	NA
	4/14/94	SDNA	SDNA	SDNA	26.66	-	0.00	26.66	NA
CPT-36	8/18/92	2670.91	3231.11	4669.78	34.97	-	0.00	34.97	4634.81
CPT-37	8/18/92	1970.30	2978.15	4625.35	26.40	-	0.00	26.40	4598.95
	4/21/93	1970.30	2978.15	4625.35	24.00	-	0.00	24.00	4601.35
	4/29/93	1970.30	2978.15	4625.35	23.75	-	0.00	23.75	4601.60
	5/6/93	1970.30	2978.15	4625.35	23.74	-	0.00	23.74	4601.61
	5/20/93	1970.30	2978.15	4625.35	23.49	-	0.00	23.49	4601.86
	6/17/93	1970.30	2978.15	4625.35	23.15	-	0.00	23.15	4602.20
	6/23/93	1970.30	2978.15	4625.35	23.10	-	0.00	23.10	4602.25
	7/1/93	1970.30	2978.15	4625.35	22.98	-	0.00	22.98	4602.37
	7/8/93	1970.30	2978.15	4625.35	22.94	-	0.00	22.94	4602.41
	12/28/93	1970.30	2978.15	4625.35	23.58	-	0.00	23.58	4601.77
	1/20/94	1970.30	2978.15	4625.35	24.12	23.72	0.40	23.82	4601.53
	2/3/94	1970.30	2978.15	4625.35	24.30	24.15	0.15	24.19	4601.16

APPENDIX B

GROUND WATER ELEVATION AND MOBILE LNAPL THICKNESS DATA
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

Sample Location	Sample Date	Easting	Northing	Datum Elevation (ft msl)	Measured Depth to Water (ft BTOC)	Depth to Product (ft BTOC)	Product Thickness (feet)	Corr. Depth to Water* (ft BTOC)	Corr. GW Elevation (ft msl)
	2/17/94	1970.30	2978.15	4625.35	24.65	24.34	0.31	24.42	4600.93
	3/3/94	1970.30	2978.15	4625.35	24.78	24.28	0.50	24.41	4600.95
	3/17/94	1970.30	2978.15	4625.35	24.84	23.84	1.00	24.09	4601.26
	3/31/94	1970.30	2978.15	4625.35	24.85	24.60	0.25	24.66	4600.69
	4/14/94	1970.30	2978.15	4625.35	25.05	24.55	0.50	24.68	4600.68
CPT-38	8/18/92	1177.69	3504.76	4615.66	13.05	-	0.00	13.05	4602.61
	3/4/93	1177.69	3504.76	4615.66	12.08	-	0.00	12.08	4603.58
	4/29/93	1177.69	3504.76	4615.66	13.33	-	0.00	13.33	4602.33
	5/6/93	1177.69	3504.76	4615.66	13.18	-	0.00	13.18	4602.48
	5/20/93	1177.69	3504.76	4615.66	13.09	-	0.00	13.09	4602.57
	6/17/93	1177.69	3504.76	4615.66	5.60	-	0.00	5.60	4610.06
	6/23/93	1177.69	3504.76	4615.66	11.94	-	0.00	11.94	4603.72
	7/1/93	1177.69	3504.76	4615.66	12.19	-	0.00	12.19	4603.47
	7/8/93	1177.69	3504.76	4615.66	11.86	-	0.00	11.86	4603.80
	8/23/93	1177.69	3504.76	4615.66	11.13	-	0.00	11.13	4604.53
	12/28/93	1177.69	3504.76	4615.66	10.16	-	0.00	10.16	4605.50
	1/20/94	1177.69	3504.76	4615.66	11.77	-	0.00	11.77	4603.89
	2/3/94	1177.69	3504.76	4615.66	13.04	-	0.00	13.04	4602.62
	2/17/94	1177.69	3504.76	4615.66	13.92	-	0.00	13.92	4601.74
	3/3/94	1177.69	3504.76	4615.66	14.71	-	0.00	14.71	4600.95
	3/17/94	1177.69	3504.76	4615.66	15.19	-	0.00	15.19	4600.47
	3/31/94	1177.69	3504.76	4615.66	15.42	-	0.00	15.42	4600.24
	4/14/94	1177.69	3504.76	4615.66	15.45	-	0.00	15.45	4600.21
CPT-40	8/18/92	2758.65	4145.21	4715.46	38.89	-	0.00	38.89	4676.57
	4/21/93	2758.65	4145.21	4715.46	52.85	-	0.00	52.85	4662.61
	4/29/93	2758.65	4145.21	4715.46	53.33	-	0.00	53.33	4662.13
	5/6/93	2758.65	4145.21	4715.46	53.17	-	0.00	53.17	4662.29
	5/20/93	2758.65	4145.21	4715.46	53.04	-	0.00	53.04	4662.42
	6/17/93	2758.65	4145.21	4715.46	53.20	-	0.00	53.20	4662.26
	6/23/93	2758.65	4145.21	4715.46	53.27	-	0.00	53.27	4662.19
	7/1/93	2758.65	4145.21	4715.46	53.22	-	0.00	53.22	4662.24
	7/8/93	2758.65	4145.21	4715.46	53.10	-	0.00	53.10	4662.36
	12/28/93	2758.65	4145.21	4715.46	51.20	-	0.00	51.20	4664.26

APPENDIX B

GROUND WATER ELEVATION AND MOBILE LNAPL THICKNESS DATA
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

Sample Location	Sample Date	Easting	Northing	Datum Elevation (ft msl)	Measured Depth to Water (ft BTOC)	Depth to Product (ft BTOC)	Product Thickness (feet)	Corr. Depth to Water* (ft BTOC)	Corr. GW Elevation (ft msl)
	1/20/94	2758.65	4145.21	4715.46	50.89	-	0.00	50.89	4664.57
	2/3/94	2758.65	4145.21	4715.46	50.52	-	0.00	50.52	4664.94
	2/17/94	2758.65	4145.21	4715.46	49.34	-	0.00	49.34	4666.12
	3/3/94	2758.65	4145.21	4715.46	48.83	-	0.00	48.83	4666.63
	3/17/94	2758.65	4145.21	4715.46	46.47	-	0.00	46.47	4668.99
	3/31/94	2758.65	4145.21	4715.46	45.93	-	0.00	45.93	4669.53
	4/14/94	2758.65	4145.21	4715.46	44.13	-	0.00	44.13	4671.33
CPT-41	6/17/93	2857.64	3142.16	4675.19	39.90	-	0.00	39.90	4635.29
	6/23/93	2857.64	3142.16	4675.19	39.28	-	0.00	39.28	4635.91
	7/1/93	2857.64	3142.16	4675.19	39.15	-	0.00	39.15	4636.04
	7/8/93	2857.64	3142.16	4675.19	39.30	-	0.00	39.30	4635.89
	12/28/93	2857.64	3142.16	4675.19	31.25	-	0.00	31.25	4643.94
	1/20/94	2857.64	3142.16	4675.19	31.31	-	0.00	31.31	4643.88
	2/3/94	2857.64	3142.16	4675.19	31.09	-	0.00	31.09	4644.10
	2/17/94	2857.64	3142.16	4675.19	30.93	-	0.00	30.93	4644.26
	3/3/94	2857.64	3142.16	4675.19	31.52	-	0.00	31.52	4643.67
	3/17/94	2857.64	3142.16	4675.19	31.35	-	0.00	31.35	4643.84
	3/31/94	2857.64	3142.16	4675.19	31.74	-	0.00	31.74	4643.45
	4/14/94	2857.64	3142.16	4675.19	32.38	-	0.00	32.38	4642.81
CPT-42	3/4/93	3067.32	3238.57	4678.34	36.93	-	0.00	36.93	4641.41
	4/2/93	3067.32	3238.57	4678.34	36.80	-	0.00	36.80	4641.54
	4/29/93	3067.32	3238.57	4678.34	37.00	-	0.00	37.00	4641.34
	5/6/93	3067.32	3238.57	4678.34	36.45	-	0.00	36.45	4641.89
	5/20/93	3067.32	3238.57	4678.34	36.00	-	0.00	36.00	4642.34
	6/17/93	3067.32	3238.57	4678[illegible]	35.37	-	0.00	35.37	4642.97
	6/23/93	3067.32	3238.57	4678.34	35.25	-	0.00	35.25	4643.09
	7/1/93	3067.32	3238.57	4678.34	33.05	-	0.00	33.05	4645.29
	7/8/93	3067.32	3238.57	4678.34	35.13	-	0.00	35.13	4643.21
	12/28/93	3067.32	3238.57	4678.34	32.99	-	0.00	32.99	4645.35
	1/20/94	3067.32	3238.57	4678.34	33.18	-	0.00	33.18	4645.16
	2/3/94	3067.32	3238.57	4678.34	33.31	-	0.00	33.31	4645.03
	2/17/94	3067.32	3238.57	4678.34	33.22	-	0.00	33.22	4645.12
	3/3/94	3067.32	3238.57	4678.34	34.00	-	0.00	34.00	4644.34

APPENDIX B

GROUND WATER ELEVATION AND MOBILE LNAPL THICKNESS DATA
UST SITE 870 INTRINSIC REMEDATION EE/CA
HILL AFB, UTAH

Sample Location	Sample Date	Easting	Northing	Datum Elevation (ft msl)	Measured Depth to Water (ft BTOC)	Depth to Product (ft BTOC)	Product Thickness (feet)	Corr. Depth to Water* (ft BTOC)	Corr. GW Elevation (ft msl)
	3/17/94	3067.32	3238.57	4678.34	33.98	-	0.00	33.98	4644.36
	3/31/94	3067.32	3238.57	4678.34	34.44	-	0.00	34.44	4643.90
	4/14/94	3067.32	3238.57	4678.34	34.89	-	0.00	34.89	4643.45
CPT-43	3/4/93	2683.44	3014.06	4659.74	29.60	-	0.00	29.60	4630.14
	4/2/93	2683.44	3014.06	4659.74	29.67	-	0.00	29.67	4630.07
	4/29/93	2683.44	3014.06	4659.74	29.35	-	0.00	29.35	4630.39
	5/6/93	2683.44	3014.06	4659.74	29.42	-	0.00	29.42	4630.32
	5/20/93	2683.44	3014.06	4659.74	29.18	-	0.00	29.18	4630.56
CPT-44	12/28/93	SDNA	SDNA	SDNA	30.83	-	0.00	30.83	NA
	1/20/94	SDNA	SDNA	SDNA	30.69	-	0.00	30.69	NA
	2/3/94	SDNA	SDNA	SDNA	30.55	-	0.00	30.55	NA
	2/17/94	SDNA	SDNA	SDNA	30.34	-	0.00	30.34	NA
	3/3/94	SDNA	SDNA	SDNA	30.76	-	0.00	30.76	NA
	3/17/94	SDNA	SDNA	SDNA	30.63	-	0.00	30.63	NA
	3/31/94	SDNA	SDNA	SDNA	30.79	-	0.00	30.79	NA
	4/14/94	SDNA	SDNA	SDNA	30.63	-	0.00	30.63	NA
EPA-82-A	8/23/93	1546.62	2945.10	4606.35	4.85	-	0.00	4.85	4601.50
	12/28/93	1546.62	2945.10	4606.35	6.22	-	0.00	6.22	4600.13
	1/20/94	1546.62	2945.10	4606.35	6.27	-	0.00	6.27	4600.08
	2/3/94	1546.62	2945.10	4606.35	6.33	-	0.00	6.33	4600.02
	2/17/94	1546.62	2945.10	4606.35	6.28	-	0.00	6.28	4600.07
	3/3/94	1546.62	2945.10	4606.35	8.94	-	0.00	8.94	4597.41
	3/17/94	1546.62	2945.10	4606.35	5.95	-	0.00	5.95	4600.40
	3/31/94	1546.62	2945.10	4606.35	8.82	-	0.00	8.82	4597.53
	4/14/94	1546.62	2945.10	4606.35	5.60	-	0.00	5.60	4600.75
EPA-82-B	8/23/93	2062.23	3063.44	4633.28	25.00	-	0.00	25.00	4608.28
	12/28/93	2062.23	3063.44	4633.28	25.49	-	0.00	25.49	4607.79
	1/20/94	2062.23	3063.44	4633.28	25.35	-	0.00	25.35	4607.93
	2/3/94	2062.23	3063.44	4633.28	25.43	-	0.00	25.43	4607.85
	2/17/94	2062.23	3063.44	4633.28	23.54	-	0.00	23.54	4609.74
	3/3/94	2062.23	3063.44	4633.28	25.69	-	0.00	25.69	4607.59
	3/17/94	2062.23	3063.44	4633.28	25.50	-	0.00	25.50	4607.78
	3/31/94	2062.23	3063.44	4633.28	25.79	-	0.00	25.79	4607.49

APPENDIX B

GROUND WATER ELEVATION AND MOBILE LNAPL THICKNESS DATA
UST SITE 870 INTRINSIC REMEDATION EE/CA
HILL AFB, UTAH

Sample Location	Sample Date	Easting	Northing	Datum Elevation (ft msl)	Measured Depth to Water (ft BTOC)	Depth to Product (ft BTOC)	Product Thickness (feet)	Corr. Depth to Water* (ft BTOC)	Corr. GW Elevation (ft msl)
	4/14/94	2062.23	3063.44	4633.28	26.02	-	0.00	26.02	4607.26
EPA-82-C	8/23/93	1840.49	3035.78	4625.17	21.80	-	0.00	21.80	4603.37
	12/28/93	1840.49	3035.78	4625.17	22.82	-	0.00	22.82	4602.35
	1/20/94	1840.49	3035.78	4625.17	23.13	-	0.00	23.13	4602.04
	2/3/94	1840.49	3035.78	4625.17	23.35	-	0.00	23.35	4601.82
	2/17/94	1840.49	3035.78	4625.17	23.54	-	0.00	23.54	4601.63
	3/3/94	1840.49	3035.78	4625.17	23.69	-	0.00	23.69	4601.48
	3/17/94	1840.49	3035.78	4625.17	23.76	-	0.00	23.76	4601.41
	3/31/94	1840.49	3035.78	4625.17	23.87	-	0.00	23.87	4601.30
	4/14/94	1840.49	3035.78	4625.17	23.94	-	0.00	23.94	4601.23
EPA-82-D	8/23/93	2167.57	3507.69	4655.39	23.69	-	0.00	23.69	4631.70
	12/28/93	2167.57	3507.69	4655.39	24.45	24.37	0.08	24.39	4631.00
	1/20/94	2167.57	3507.69	4655.39	24.60	24.53	0.07	24.55	4630.84
	2/3/94	2167.57	3507.69	4655.39	24.69	24.42	0.27	24.49	4630.90
	2/17/94	2167.57	3507.69	4655.39	24.51	24.36	0.15	24.40	4630.99
	3/3/94	2167.57	3507.69	4655.39	24.93	24.92	0.01	24.92	4630.47
	3/17/94	2167.57	3507.69	4655.39	24.88	24.80	0.08	24.82	4630.57
	3/31/94	2167.57	3507.69	4655.39	25.09	24.99	0.10	25.02	4630.38
	4/14/94	2167.57	3507.69	4655.39	25.17	-	0.00	25.17	4630.22
EPA-82-E	8/23/93	1345.36	2845.36	4600.13	4.92	-	0.00	4.92	4595.21
	12/28/93	1345.36	2845.36	4600.13	7.32	-	0.00	7.32	4592.81
	1/20/94	1345.36	2845.36	4600.13	7.58	-	0.00	7.58	4592.55
	2/3/94	1345.36	2845.36	4600.13	7.75	-	0.00	7.75	4592.38
	2/17/94	1345.36	2845.36	4600.13	7.81	-	0.00	7.81	4592.32
	3/3/94	1345.36	2845.36	4600.13	7.21	-	0.00	7.21	4592.92
	3/17/94	1345.36	2845.36	4600.13	7.14	-	0.00	7.14	4592.99
	3/31/94	1345.36	2845.36	4600.13	6.92	-	0.00	6.92	4593.21
	4/14/94	1345.36	2845.36	4600.13	6.70	-	0.00	6.70	4593.43
EPA-82-F	8/23/93	1543.19	2943.57	4606.19	6.13	-	0.00	6.13	4600.06
	12/28/93	1543.19	2943.57	4606.19	8.28	-	0.00	8.28	4597.91
	1/20/94	1543.19	2943.57	4606.19	8.43	-	0.00	8.43	4597.76
	2/3/94	1543.19	2943.57	4606.19	8.54	-	0.00	8.54	4597.65
	2/17/94	1543.19	2943.57	4606.19	8.63	-	0.00	8.63	4597.56

APPENDIX B

GROUND WATER ELEVATION AND MOBILE LNAPL THICKNESS DATA
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

Sample Location	Sample Date	Easting	Northing	Datum Elevation (ft msl)	Measured Depth to Water (ft BTOC)	Depth to Product (ft BTOC)	Product Thickness (feet)	Corr. Depth to Water* (ft BTOC)	Corr. GW Elevation (ft msl)
	3/3/94	1543.19	2943.57	4606.19	7.97	-	0.00	7.97	4598.22
	3/17/94	1543.19	2943.57	4606.19	7.75	-	0.00	7.75	4598.44
	3/31/94	1543.19	2943.57	4606.19	7.53	-	0.00	7.53	4598.66
	4/14/94	1543.19	2943.57	4606.19	7.37	-	0.00	7.37	4598.82
EPA-82-H	8/23/93	1964.51	2719.71	4610.81	11.15	0.00	0.00	11.15	4599.66
	12/28/93	1964.51	2719.71	4610.81	12.34	-	0.00	12.34	4598.47
	1/20/94	1964.51	2719.71	4610.81	12.58	-	0.00	12.58	4598.23
	2/3/94	1964.51	2719.71	4610.81	12.74	-	0.00	12.74	4598.07
	2/17/94	1964.51	2719.71	4610.81	12.92	-	0.00	12.92	4597.89
	3/3/94	1964.51	2719.71	4610.81	12.91	-	0.00	12.91	4597.90
	3/17/94	1964.51	2719.71	4610.81	13.00	-	0.00	13.00	4597.81
	3/31/94	1964.51	2719.71	4610.81	13.03	-	0.00	13.03	4597.78
	4/14/94	1964.51	2719.71	4610.81	13.03	-	0.00	13.03	4597.78
EPA-82-I	8/23/93	2520.42	3771.26	4683.08	18.55	-	0.00	18.55	4664.53
	12/28/93	2520.42	3771.26	4683.08	20.29	-	0.00	20.29	4662.79
	1/20/94	2520.42	3771.26	4683.08	22.51	-	0.00	22.51	4660.57
	2/3/94	2520.42	3771.26	4683.08	20.46	-	0.00	20.46	4662.62
	2/17/94	2520.42	3771.26	4683.08	20.41	-	0.00	20.41	4662.67
	3/3/94	2520.42	3771.26	4683.08	20.84	-	0.00	20.84	4662.24
	3/17/94	2520.42	3771.26	4683.08	20.61	-	0.00	20.61	4662.47
	3/31/94	2520.42	3771.26	4683.08	20.59	-	0.00	20.59	4662.49
	4/14/94	2520.42	3771.26	4683.08	20.30	-	0.00	20.30	4662.78
MW-1	3/18/93	2475.32	3841.98	4683.91	22.80	22.75	0.05	22.76	4661.15
	4/21/93	2475.32	3841.98	4683.91	23.10	20.18	2.92	20.91	4663.00
	4/29/93	2475.32	3841.98	4683.91	22.77	19.39	3.38	20.24	4663.68
	5/6/93	2475.32	3841.98	4683.91	22.00	19.04	2.96	19.78	4664.13
	5/20/93	2475.32	3841.98	4683.91	20.14	19.07	1.07	19.34	4664.57
	6/17/93	2475.32	3841.98	4683.91	18.97	18.69	0.28	18.76	4665.15
	6/23/93	2475.32	3841.98	4683.91	19.02	18.66	0.36	18.75	4665.16
	7/1/93	2475.32	3841.98	4683.91	18.60	-	0.00	18.60	4665.31
	7/8/93	2475.32	3841.98	4683.91	18.85	18.56	0.29	18.63	4665.28
	12/28/93	2475.32	3841.98	4683.91	19.42	19.42	0.00	19.42	4664.49
	1/20/94	2475.32	3841.98	4683.91	19.80	19.79	0.01	19.79	4664.12

APPENDIX B

GROUND WATER ELEVATION AND MOBILE LNAPL THICKNESS DATA
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

Sample Location	Sample Date	Easting	Northing	Datum Elevation (ft msl)	Measured Depth to Water (ft BTOC)	Depth to Product (ft BTOC)	Product Thickness (feet)	Corr. Depth to Water* (ft BTOC)	Corr. GW Elevation (ft msl)
	2/17/94	2475.32	3841.98	4683.91	19.52	19.51	0.01	19.51	4664.40
	3/3/94	2475.32	3841.98	4683.91	20.31	20.30	0.01	20.30	4663.61
	3/17/94	2475.32	3841.98	4683.91	20.40	-	0.00	20.40	4663.51
	3/31/94	2475.32	3841.98	4683.91	20.42	-	0.00	20.42	4663.49
	4/14/94	2475.32	3841.98	4683.91	22.01	-	0.00	22.01	4661.90
MW-02	2/12/93	2389.21	3846.24	4684.39	25.20	-	0.00	25.20	4659.19
	3/18/93	2389.21	3846.24	4684.39	25.11	-	0.00	25.11	4659.28
	4/21/93	2389.21	3846.24	4684.39	23.93	-	0.00	23.93	4660.46
	4/29/93	2389.21	3846.24	4684.39	23.69	-	0.00	23.69	4660.70
	5/6/93	2389.21	3846.24	4684.39	23.44	-	0.00	23.44	4660.95
	5/20/93	2389.21	3846.24	4684.39	23.01	-	0.00	23.01	4661.38
	6/17/93	2389.21	3846.24	4684.39	22.57	22.44	0.13	22.47	4661.92
	6/23/93	2389.21	3846.24	4684.39	22.61	22.40	0.21	22.45	4661.94
	7/1/93	2389.21	3846.24	4684.39	22.54	22.27	0.27	22.34	4662.05
	7/8/93	2389.21	3846.24	4684.39	22.62	22.26	0.36	22.35	4662.04
	12/28/93	2389.21	3846.24	4684.39	23.77	23.74	0.03	23.75	4660.64
	1/20/94	2389.21	3846.24	4684.39	24.04	24.03	0.01	24.03	4660.36
	2/3/94	2389.21	3846.24	4684.39	24.06	24.05	0.01	24.05	4660.34
	2/17/94	2389.21	3846.24	4684.39	24.06	24.05	0.01	24.05	4660.34
	3/3/94	2389.21	3846.24	4684.39	24.24	24.23	0.01	24.23	4660.16
	3/17/94	2389.21	3846.24	4684.39	22.24	-	0.00	22.24	4662.15
	3/31/94	2389.21	3846.24	4684.39	24.24	-	0.00	24.24	4660.15
	4/14/94	2389.21	3846.24	4684.39	24.16	-	0.00	24.16	4660.23
MW-03	2/12/93	2533.09	3882.19	4690.67	28.93	28.91	0.02	28.92	4661.76
	3/18/93	2533.09	3882.19	4690.67	28.08	27.69	0.39	27.79	4662.88
	4/21/93	2533.09	3882.19	4690.67	24.25	23.78	0.97	23.52	4667.15
	4/29/93	2533.09	3882.19	4690.67	23.61	23.57	0.04	23.58	4667.09
	5/6/93	2533.09	3882.19	4690.67	23.53	23.21	0.32	23.29	4667.38
	5/20/93	2533.09	3882.19	4690.67	23.00	22.60	0.40	22.70	4667.97
	6/17/93	2533.09	3882.19	4690.67	22.91	22.58	0.33	22.66	4668.01
	6/23/93	2533.09	3882.19	4690.67	22.68	22.40	0.28	22.47	4668.20
	7/1/93	2533.09	3882.19	4690.67	22.48	22.29	0.19	22.34	4668.33
	7/8/93	2533.09	3882.19	4690.67	23.04	22.33	0.71	22.51	4668.16

APPENDIX B

GROUND WATER ELEVATION AND MOBILE LNAPL THICKNESS DATA
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

Sample Location	Sample Date	Easting	Northing	Datum Elevation (ft msl)	Measured Depth to Water (ft BTOC)	Depth to Product (ft BTOC)	Product Thickness (feet)	Corr. Depth to Water* (ft BTOC)	Corr. GW Elevation (ft msl)
	12/28/93	2533.09	3882.19	4690.67	23.94	23.88	0.06	23.90	4666.78
	1/20/94	2533.09	3882.19	4690.67	23.89	23.74	0.15	23.78	4666.89
	2/17/94	2533.09	3882.19	4690.67	23.65	23.49	0.16	23.53	4667.14
	3/3/94	2533.09	3882.19	4690.67	24.32	24.05	0.27	24.12	4666.55
	3/17/94	2533.09	3882.19	4690.67	24.27	24.03	0.24	24.09	4666.58
	3/31/94	2533.09	3882.19	4690.67	24.42	24.10	0.32	24.18	4666.49
	4/14/94	2533.09	3882.19	4690.67	24.62	23.89	0.64	24.14	4666.53
MW-04	3/18/93	2446.70	3798.05	4682.13	21.65	-	0.00	21.65	4660.48
	4/21/93	2446.70	3798.05	4682.13	20.05	19.80	0.25	19.86	4662.27
	4/29/93	2446.70	3798.05	4682.13	19.75	19.32	0.43	19.43	4662.70
	5/6/93	2446.70	3798.05	4682.13	19.40	18.93	0.47	19.05	4663.08
	5/20/93	2446.70	3798.05	4682.13	18.54	18.21	0.33	18.29	4663.84
	6/17/93	2446.70	3798.05	4682.13	18.55	18.30	0.25	18.36	4663.77
	6/23/93	2446.70	3798.05	4682.13	18.79	18.36	0.43	18.47	4663.66
	7/1/93	2446.70	3798.05	4682.13	18.54	18.41	0.13	18.44	4663.69
	7/8/93	2446.70	3798.05	4682.13	18.57	18.45	0.12	18.48	4663.65
	12/28/93	2446.70	3798.05	4682.13	20.38	20.27	0.11	20.30	4661.83
	1/20/94	2446.70	3798.05	4682.13	20.63	20.48	0.15	20.52	4661.61
	2/17/94	2446.70	3798.05	4682.13	20.52	20.51	0.01	20.51	4661.62
	3/3/94	2446.70	3798.05	4682.13	20.81	20.80	0.01	20.80	4661.33
	3/17/94	2446.70	3798.05	4682.13	20.68	-	0.00	20.68	4661.45
	3/31/94	2446.70	3798.05	4682.13	20.61	-	0.00	20.61	4661.52
	4/14/94	2446.70	3798.05	4682.13	20.05	-	0.00	20.05	4662.08
MW-5	2/12/93	2536.47	3813.49	4686.76	25.00	-	0.00	25.00	4661.76
	3/18/93	2536.47	3813.49	4686.76	20.95	-	0.00	20.95	4665.81
	4/21/93	2536.47	3813.49	4686.76	20.03	18.78	1.25	19.09	4667.67
	4/29/93	2536.47	3813.49	4686.76	20.01	18.29	1.72	18.72	4668.04
	5/6/93	2536.47	3813.49	4686.76	20.03	18.10	1.93	18.58	4668.18
	5/20/93	2536.47	3813.49	4686.76	19.43	17.96	1.47	18.33	4668.43
	6/17/93	2536.47	3813.49	4686.76	18.95	18.17	0.78	18.37	4668.40
	6/23/93	2536.47	3813.49	4686.76	19.36	18.12	1.24	18.43	4668.33
	7/1/93	2536.47	3813.49	4686.76	18.78	18.56	0.22	18.62	4668.15
	7/8/93	2536.47	3813.49	4686.76	18.55	18.41	0.14	18.45	4668.32

APPENDIX B

GROUND WATER ELEVATION AND MOBILE LNAPL THICKNESS DATA
UST SITE 870 INTRINSIC REMEDATION EE/CA
HILL AFB, UTAH

Sample Location	Sample Date	Easting	Northing	Datum Elevation (ft msl)	Measured Depth to Water (ft BTOC)	Depth to Product (ft BTOC)	Product Thickness (feet)	Corr. Depth to Water* (ft BTOC)	Corr. GW Elevation (ft msl)
	12/28/93	2536.47	3813.49	4686.76	20.79	20.78	0.01	20.78	4665.98
	1/20/94	2536.47	3813.49	4686.76	21.34	21.33	0.01	21.33	4665.43
	2/17/94	2536.47	3813.49	4686.76	21.18	21.17	0.01	21.17	4665.59
	3/3/94	2536.47	3813.49	4686.76	21.48	21.47	0.01	21.47	4665.29
	3/17/94	2536.47	3813.49	4686.76	21.45	-	0.00	21.45	4665.31
	3/31/94	2536.47	3813.49	4686.76	21.14	-	0.00	21.14	4665.62
	4/14/94	2536.47	3813.49	4686.76	20.99	-	0.00	20.99	4665.77
MW-6	3/18/93	2389.06	3794.35	4679.03	22.06	-	0.00	22.06	4656.97
	4/21/93	2389.06	3794.35	4679.03	21.31	-	0.00	21.31	4657.72
	4/29/93	2389.06	3794.35	4679.03	21.10	-	0.00	21.10	4657.93
	5/6/93	2389.06	3794.35	4679.03	20.82	-	0.00	20.82	4658.21
	5/20/93	2389.06	3794.35	4679.03	20.33	-	0.00	20.33	4658.70
	6/17/93	2389.06	3794.35	4679.03	19.90	-	0.00	19.90	4659.13
	6/23/93	2389.06	3794.35	4679.03	19.84	-	0.00	19.84	4659.19
	7/1/93	2389.06	3794.35	4679.03	19.72	-	0.00	19.72	4659.31
	7/8/93	2389.06	3794.35	4679.03	19.69	-	0.00	19.69	4659.34
	12/28/93	2389.06	3794.35	4679.03	20.92	20.79	0.13	20.82	4658.21
	1/20/94	2389.06	3794.35	4679.03	20.92	20.91	0.01	20.91	4658.12
	2/3/94	2389.06	3794.35	4679.03	20.59	20.58	0.01	20.58	4658.45
	2/17/94	2389.06	3794.35	4679.03	20.74	20.73	0.01	20.73	4658.30
	3/3/94	2389.06	3794.35	4679.03	21.14	21.13	0.01	21.13	4657.90
	3/17/94	2389.06	3794.35	4679.03	21.10	-	0.00	21.10	4657.93
	3/31/94	2389.06	3794.35	4679.03	21.08	-	0.00	21.08	4657.95
	4/14/94	2389.06	3794.35	4679.03	21.05	-	0.00	21.05	4657.98
MW-7 (TWP-3)	2/12/93	2621.27	3900.79	4693.80	31.61	-	0.00	31.61	4662.19
	3/18/93	2621.27	3900.79	4693.80	31.52	-	0.00	31.52	4662.28
	4/21/93	2621.27	3900.79	4693.80	30.56	-	0.00	30.56	4663.24
	4/29/93	2621.27	3900.79	4693.80	30.32	-	0.00	30.32	4663.48
	5/6/93	2621.27	3900.79	4693.80	30.06	-	0.00	30.06	4663.74
	5/20/93	2621.27	3900.79	4693.80	29.70	-	0.00	29.70	4664.10
	6/17/93	2621.27	3900.79	4693.80	29.23	-	0.00	29.23	4664.57
	6/23/93	2621.27	3900.79	4693.80	29.15	-	0.00	29.15	4664.65
	7/1/93	2621.27	3900.79	4693.80	28.91	-	0.00	28.91	4664.89

APPENDIX B

GROUND WATER ELEVATION AND MOBILE LNAPL THICKNESS DATA
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

Sample Location	Sample Date	Easting	Northing	Datum Elevation (ft msl)	Measured Depth to Water (ft BTOC)	Depth to Product (ft BTOC)	Product Thickness (feet)	Corr. Depth to Water* (ft BTOC)	Corr. GW Elevation (ft msl)
	7/8/93	2621.27	3900.79	4693.80	28.79	-	0.00	28.79	4665.01
	12/28/93	2621.27	3900.79	4693.80	25.87	-	0.00	25.87	4667.93
	1/20/94	2621.27	3900.79	4693.80	25.96	-	0.00	25.96	4667.84
	2/3/94	2621.27	3900.79	4693.80	25.82	-	0.00	25.82	4667.98
	2/17/94	2621.27	3900.79	4693.80	25.68	-	0.00	25.68	4668.12
	3/3/94	2621.27	3900.79	4693.80	29.22	-	0.00	29.22	4664.58
	3/17/94	2621.27	3900.79	4693.80	26.21	-	0.00	26.21	4667.59
	3/31/94	2621.27	3900.79	4693.80	26.32	-	0.00	26.32	4667.48
	4/14/94	2621.27	3900.79	4693.80	26.37	-	0.00	26.37	4667.43
MW-8 (TWP-1)	3/18/93	2449.70	3893.96	4688.02	24.92	24.72	0.20	24.77	4663.25
	4/21/93	2449.70	3893.96	4688.02	23.47	23.42	0.05	23.43	4664.59
	4/29/93	2449.70	3893.96	4688.02	23.21	22.90	0.31	22.98	4665.04
	5/6/93	2449.70	3893.96	4688.02	22.85	22.50	0.35	22.59	4665.43
	5/20/93	2449.70	3893.96	4688.02	22.50	22.08	0.42	22.19	4665.84
	6/17/93	2449.70	3893.96	4688.02	21.72	21.71	0.01	21.71	4666.31
	6/23/93	2449.70	3893.96	4688.02	21.95	21.81	0.14	21.85	4666.18
	7/1/93	2449.70	3893.96	4688.02	21.75	21.60	0.15	21.64	4666.38
	7/8/93	2449.70	3893.96	4688.02	21.82	21.72	0.10	21.75	4666.28
	12/28/93	2449.70	3893.96	4688.02	21.42	21.33	0.09	21.35	4666.67
	1/20/94	2449.70	3893.96	4688.02	21.63	21.55	0.08	21.57	4666.45
	2/17/94	2449.70	3893.96	4688.02	21.17	21.16	0.01	21.16	4666.86
	3/3/94	2449.70	3893.96	4688.02	21.75	21.74	0.01	21.74	4666.28
	3/17/94	2449.70	3893.96	4688.02	21.65	-	0.00	21.65	4666.37
	3/31/94	2449.70	3893.96	4688.02	21.93	-	0.00	21.93	4666.09
	4/14/94	2449.70	3893.96	4688.02	21.82	21.82	0.00	21.82	4666.20
MW-9 (TWP-2)	3/18/93	2529.21	3930.05	4692.09	27.25	26.90	0.35	26.99	4665.10
	4/21/93	2529.21	3930.05	4692.09	24.64	24.44	0.20	24.49	4667.60
	4/29/93	2529.21	3930.05	4692.09	24.30	23.81	0.49	23.93	4668.16
	5/6/93	2529.21	3930.05	4692.09	23.84	23.44	0.40	23.54	4668.55
	5/20/93	2529.21	3930.05	4692.09	23.24	22.76	0.48	22.88	4669.21
	6/17/93	2529.21	3930.05	4692.09	22.36	22.00	0.36	22.09	4670.00
	6/23/93	2529.21	3930.05	4692.09	22.59	21.91	0.68	22.08	4670.01
	7/1/93	2529.21	3930.05	4692.09	21.94	21.66	0.28	21.73	4670.36

APPENDIX B

GROUND WATER ELEVATION AND MOBILE LNAPL THICKNESS DATA
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

Sample Location	Sample Date	Easting	Northing	Datum Elevation (ft msl)	Measured Depth to Water (ft BTOC)	Depth to Product (ft BTOC)	Product Thickness (feet)	Corr. Depth to Water* (ft BTOC)	Corr. GW Elevation (ft msl)
	7/8/93	2529.21	3930.05	4692.09	22.03	21.61	0.42	21.72	4670.38
	12/28/93	2529.21	3930.05	4692.09	21.77	21.51	0.26	21.58	4670.52
	!/20/94	2529.21	3930.05	4692.09	22.63	21.90	0.73	22.08	4670.01
	2/17/94	2529.21	3930.05	4692.09	21.75	21.73	0.02	21.74	4670.36
	3/3/94	2529.21	3930.05	4692.09	22.28	22.27	0.01	22.27	4669.82
	3/17/94	2529.21	3930.05	4692.09	22.43	22.23	0.20	22.28	4669.81
	3/31/94	2529.21	3930.05	4692.09	22.86	22.45	0.41	22.55	4669.54
	4/14/94	2529.21	3930.05	4692.09	22.69	22.39	0.30	22.47	4669.63
MW-10	2/12/93	2354.84	3397.60	4662.67	30.18	29.18	1.00	29.43	4633.24
	3/18/93	2354.84	3397.60	4662.67	29.90	29.02	0.88	29.24	4633.43
	4/2/93	2354.84	3397.60	4662.67	30.10	29.12	0.98	29.37	4633.31
	4/21/93	2354.84	3397.60	4662.67	30.12	29.11	1.01	29.36	4633.31
	4/29/93	2354.84	3397.60	4662.67	30.07	29.03	1.04	29.29	4633.38
	5/6/93	2354.84	3397.60	4662.67	29.85	28.77	1.08	29.04	4633.63
	5/20/93	2354.84	3397.60	4662.67	29.73	28.63	1.10	28.91	4633.77
	6/17/93	2354.84	3397.60	4662.67	29.43	28.35	1.08	28.62	4634.05
	6/23/93	2354.84	3397.60	4662.67	29.68	28.48	1.20	28.78	4633.89
	7/1/93	2354.84	3397.60	4662.67	29.50	28.31	1.19	28.61	4634.06
	7/8/93	2354.84	3397.60	4662.67	29.51	28.29	1.22	28.60	4634.08
	8/23/93	2354.84	3397.60	4662.67	28.44	28.26	0.00	28.44	4634.23
	12/28/93	2354.84	3397.60	4662.67	28.47	28.27	0.20	28.32	4634.35
	1/20/94	2354.84	3397.60	4662.67	28.48	28.34	0.14	28.38	4634.30
	2/3/94	2354.84	3397.60	4662.67	28.21	27.99	0.22	28.05	4634.63
	2/17/94	2354.84	3397.60	4662.67	28.10	27.90	0.20	27.95	4634.72
	3/3/94	2354.84	3397.60	4662.67	28.79	28.74	0.05	28.75	4633.92
	3/17/94	2354.84	3397.60	4662.67	28.42	28.35	0.07	28.37	4634.30
	3/31/94	2354.84	3397.60	4662.67	28.69	28.60	0.09	28.62	4634.05
	4/14/94	2354.84	3397.60	4662.67	28.97	28.95	0.02	28.96	4633.72
MW-11	2/12/93	1923.08	3213.91	4637.37	26.73	-	0.00	26.73	4610.64
	3/18/93	1923.08	3213.91	4637.37	26.20	-	0.00	26.20	4611.17
	4/2/93	1923.08	3213.91	4637.37	26.00	-	0.00	26.00	4611.37
	4/21/93	1923.08	3213.91	4637.37	25.98	-	0.00	25.98	4611.39
	4/29/93	1923.08	3213.91	4637.37	25.98	-	0.00	25.98	4611.39

APPENDIX B

GROUND WATER ELEVATION AND MOBILE LNAPL THICKNESS DATA
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

Sample Location	Sample Date	Easting	Northing	Datum Elevation (ft msl)	Measured Depth to Water (ft BTOC)	Depth to Product (ft BTOC)	Product Thickness (feet)	Corr. Depth to Water* (ft BTOC)	Corr. GW Elevation (ft msl)
	5/6/93	1923.08	3213.91	4637.37	25.79	-	0.00	25.79	4611.58
	5/20/93	1923.08	3213.91	4637.37	25.85	-	0.00	25.85	4611.52
	6/17/93	1923.08	3213.91	4637.37	25.62	-	0.00	25.62	4611.75
	6/23/93	1923.08	3213.91	4637.37	25.75	-	0.00	25.75	4611.62
	7/1/93	1923.08	3213.91	4637.37	25.74	-	0.00	25.74	4611.63
	7/8/93	1923.08	3213.91	4637.37	26.70	-	0.00	26.70	4610.67
	8/23/93	1923.08	3213.91	4637.37	26.37	-	0.00	26.37	4611.00
	12/28/93	1923.08	3213.91	4637.37	26.67	-	0.00	26.67	4610.70
	1/20/94	1923.08	3213.91	4637.37	26.49	-	0.00	26.49	4610.88
	2/3/94	1923.08	3213.91	4637.37	26.55	[illegible]	0.00	26.55	4610.82
	2/17/94	1923.08	3213.91	4637.37	26.41	[illegible]	0.00	26.41	4610.96
	3/3/94	1923.08	3213.91	4637.37	26.78	[illegible]	0.00	26.78	4610.59
	3/17/94	1923.08	3213.91	4637.37	26.45	-	0.00	26.45	4610.92
	3/31/94	1923.08	3213.91	4637.37	26.85	-	0.00	26.85	4610.52
	4/14/94	1923.08	3213.91	4637.37	26.82	-	0.00	26.82	4610.55
MW-12	2/12/93	2457.72	3650.34	4676.87	25.84	25.75	0.09	25.77	4651.10
	3/18/93	2457.72	3650.34	4676.87	25.80	25.70	0.10	25.73	4651.15
	4/2/93	2457.72	3650.34	4676.87	25.71	25.62	0.09	25.64	4651.23
	4/21/93	2457.72	3650.34	4676.87	25.35	25.31	0.04	25.32	4651.55
	4/29/93	2457.72	3650.34	4676.87	25.29	25.27	0.02	25.28	4651.60
	5/6/93	2457.72	3650.34	4676.87	25.16	-	0.00	25.16	4651.71
	5/20/93	2457.72	3650.34	4676.87	24.83	-	0.00	24.83	4652.04
	6/17/93	2457.72	3650.34	4676.87	24.02	24.01	0.01	24.01	4652.86
	6/23/93	2457.72	3650.34	4676.87	24.00	23.99	0.01	23.99	4652.88
	7/1/93	2457.72	3650.34	4676.87	23.77	23.75	0.02	23.76	4653.12
	7/8/93	2457.72	3650.34	4676.87	23.87	23.84	0.03	23.85	4653.02
	8/23/93	2457.72	3650.34	4676.87	23.14	23.13	0.00	23.14	4653.73
	12/28/93	2457.72	3650.34	4676.87	23.21	23.20	0.01	23.20	4653.67
	1/20/94	2457.72	3650.34	4676.87	23.28	23.27	0.01	23.27	4653.60
	2/3/94	2457.72	3650.34	4676.87	23.16	23.15	0.01	23.15	4653.72
	2/17/94	2457.72	3650.34	4676.87	23.02	22.87	0.15	22.91	4653.96
	3/3/94	2457.72	3650.34	4676.87	23.75	23.74	0.01	23.74	4653.13
	3/17/94	2457.72	3650.34	4676.87	23.44	-	0.00	23.44	4653.43

APPENDIX B

GROUND WATER ELEVATION AND MOBILE LNAPL THICKNESS DATA
UST SITE 870 INTRINSIC REMEDIATION EE/CA
HILL AFB, UTAH

Sample Location	Sample Date	Easting	Northing	Datum Elevation (ft msl)	Measured Depth to Water (ft BTOC)	Depth to Product (ft BTOC)	Product Thickness (feet)	Corr. Depth to Water* (ft BTOC)	Corr. GW Elevation (ft msl)
	3/31/94	2457.72	3650.34	4676.87	23.80	-	0.00	23.80	4653.07
	4/14/94	2457.72	3650.34	4676.87	24.11	-	0.00	24.11	4652.76
MW-13	12/28/93	2573.50	3896.74	4689.21	25.93	19.75	6.18	21.30	4667.92
	1/20/94	2573.50	3896.74	4689.21	23.67	21.74	1.93	22.22	4666.99
	2/3/94	2573.50	3896.74	4689.21	23.86	21.48	2.38	22.08	4667.14
	2/17/94	2573.50	3896.74	4689.21	23.88	21.30	2.58	21.95	4667.27
	3/3/94	2573.50	3896.74	4689.21	24.29	21.92	2.37	22.51	4666.70
	3/17/94	2573.50	3896.74	4689.21	24.43	21.82	2.61	22.47	4666.74
	3/31/94	2573.50	3896.74	4689.21	23.21	22.71	0.50	22.84	4666.38
	4/14/94	2573.50	3896.74	4689.21	22.95	22.70	0.25	22.76	4666.45
MW-14	12/28/93	2548.14	3861.96	4686.21	26.21	21.25	4.96	22.49	4663.72
	1/20/94	2548.14	3861.96	4686.21	23.40	21.01	2.39	21.61	4664.60
	2/3/94	2548.14	3861.96	4686.21	23.09	20.59	3.31	20.61	4665.60
	2/17/94	2548.14	3861.96	4686.21	24.50	20.18	4.32	21.26	4664.95
	3/3/94	2548.14	3861.96	4686.21	25.78	20.63	5.15	21.92	4664.29
	3/17/94	2548.14	3861.96	4686.21	28.42	24.44	3.98	25.44	4660.78
	3/31/94	2548.14	3861.96	4686.21	23.05	22.43	0.62	22.59	4663.63
	4/14/94	2548.14	3861.96	4686.21	22.50	22.12	0.38	22.22	4664.00

SDNA = Surveyor's Data Not Available

* Corrected Depth to Water = Measured Depth to Water - (0.75 x Product Thickness)

NA = Not Available

ft msl = Feet Above Mean Sea Level

ft BTOC = Feet Below Top of Casing

APPENDIX C

SOIL AND GROUND WATER ANALYTICAL DATA

MANTECH

Ref: 93-BN4/vg

August 16, 1993

Dr. Don Kampbell
R.S. Kerr Environmental Research Lab
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

ATTENTION OF: Roger L. Cosby

Dear Don:

Please find attached test results for methane, carbon dioxide, and oxygen on Hill AFB samples as per Service Request #SF-0-1. Samples were received on August 5 and 9, 1993, and analyzed on August 9-10, 1993. Samples were prepared as described in the paper "Dissolved Oxygen and Methane in Water by a GC Headspace Equilibrium Technique", by Kampbell et al., in International Journal of Environmental Chemistry, Vol. 36, pp. 249-257. Analysis and calculations of carbon dioxide and oxygen were performed as per RSKSOP-114(TCD). Analysis and calculations of methane were performed as per RSKSOP-147(FID).

If you have any questions, please feel free to see me.

Sincerely,

Bryan Newell

Bryan Newell

xc: J.L. Seeley
S.A. Vandegrift
J.T. Wilson
M. Cook

SF-0-1 DATA

ANALYZED 8/9-10/93

SAMPLE	METHANE	CARBON DIOXIDE	OXYGEN
71-CPT-GEO DEPTH1	0.0192	838	6.09
71-8CPT-GEO DEPTH1	0.0212	1224	0.93
71-17CPT-GEO DEPTH1	0.0044	518	8.68
71-17CPT-GE0 DEPTH2	0.0064	607	2.58
71-18CPT-GEO DEPTH1	0.0007	398	6.80
71-18CPT-GEO DEPTH2	0.0017	479	2.78
71-19CPT-GEO DEPTH1	0.0564	708	2.50
71-19CPT-GEO DEPTH1 DUP	0.0552	707	0.81
71-23CPT-GEO DEPTH1	0.0001	433	6.91
71-29CPT-GEO DEPTH1	0.0007	380	4.67
71-29CPT-GEO DEPTH2	0.0541	364	2.52
71-31CPT-GEO DEPTH1	0.0032	511	7.21
71-31CPT-GEO DEPTH2	0.0111	603	7.17
71-38CPT-GEO DEPTH1	0.0350	897	4.19
71-39CPT-GEO DEPTH1	0.0141	761	1.70
71-39CPT-GEO DEPTH1 DUP	0.0219	1183	1.42
LOWER LIMIT OF QUANTITATION	0.0009	0.17	0.29
UPPER LIMIT OF QUANTITATION	0.9445	1521	52.37

UNITS ARE mg/L.

Missing data on EPA wells.

Ref: 93-TH9/vg
93-PR9/vg
93-LP5/vg

August 17, 1993

Dr Don Kampbell
R.S. Kerr Environmental Research Lab
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

ATTENTION OF: Roger L. Cosby

Dear Don:

Attached are the results of 14 Hill AFB samples submitted to ManTech Environmental as part of Service Request #SF-0-1. The samples were received on August 6 and 9, 1993, and analyzed August 6, 9, 10, and 11, 1993. The methods used for analysis were EPA methods 350.1, 353.1, and 365.1 and Water's capillary electrophoresis method N-601. Blanks, spikes, duplicates, and known AQC samples were analyzed along with the samples for quality assurance.

If you have any questions concerning these results, please feel free to contact us.

Sincerely,

Priscilla Rhynes for TH

Tim Hensley

Priscilla Rhynes

Priscilla Rhynes

Lynda Pennington

Lynda Pennington

xc: S.A. Vandegrift SAV
J.L. Seeley JS

ManTech Environmental Technology, Inc.

P.O. Box 1198, Ada, Oklahoma 74820 405-332-8800 FAX 405-332-8800 ext. 235

8/5/93 Sample	mg/l Cl^-	mg/l $SO_4^=$	mg/l $NO_2^-+NO_3^-(N)$	mg/l $NH_3(N)$	mg/l T-P(P)
71-17CPT-GEO Depth 1	71.5	74.4	3.78	.30	6.21
71-17CPT-GEO Depth 2	189	8.05	2.13	.21	6.23
71-18CPT-GEO Depth 1	109	34.8	1.85	.26	8.40
71-18CPT-GEO Depth 1 Dup	108	34.6	1.91	.17	
71-18CPT-GEO Depth 2	90.2	39.4	3.89	.11	13.6
71-18CPT-GEO Depth 2 Dup	90.3	39.8			13.3
71-19CPT-GEO Depth 1	50.5	5.68	.19	.99	5.55
71-29CPT-GEO Depth 1	----	----	1.40	.30	
71-29CPT-GEO Depth 2	107	52.6	3.90	<.05	.10
71-29CPT-GEO Depth 7	----	----	1.59	.19	<.05
71-29CPT-GEO Depth 7 Dup					<.05
71-31CPT-GEO Depth 1	93.2	46.9	3.66	<.05	9.42
71-31CPT-GEO Depth 2	91.7	47.4	4.69	<.05	5.94
71-38CPT-GEO Depth 1	170	58.0	3.77	<.05	4.33
8/9/93					
71-23CPT-GEO Depth 1	118	51.2	2.70	.14	6.64
71-23CPT-GEO Depth 1 Dup					6.74
71-39CPT-GEO Depth 1	161	56.8	4.17	<.05	6.96
71-39CPT-GEO Depth 2	114	31.5	4.13	<.05	5.46
71-39CPT-GEO Depth 2 Dup	116				
AQCWP030	----	----	7.04	9.68	3.27
			7.12	9.66	3.29
True Value	----	----	7.10	9.80	
Spike Recovery	103%	101%	104%	106%	102%
	94%	92%	99%	103%	99%

MANTECH ENVIRONMENTAL TECHNOLOGY

Ref: 93-LP8/vg

August 25, 1993

Dr. Don Kampbell
R.S. Kerr Environmental Research Lab
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

THRU: S.A. Vandegrift SAV

Dear Don:

Below are TOC results for a set of nine aqueous samples submitted to ManTech Environmental August 24, 1993 as a part of Service Request #SF-0-5. The samples were analyzed on the day of receipt using RSKSOP-102. Blanks, duplicates, and known PE samples were analyzed along with your samples for quality control.

Please note that sample "82-MW-10" exhibited an immiscible phase floating on the surface of the sample. An aliquot of sample was taken from below this phase for analysis of TOC.

If you have any further questions concerning this data, please feel free to contact me.

Sincerely,

Lynda Pennington

Lynda Pennington

xc: R.L. Cosby
J.L. Seeley
J.T. Wilson

Sample	mg/L TOC
82A	4.2
82B	2.1
82C	9.4
82C Dup	9.5
82D	8.1
82E	1.7
82F	2.2
82H	2.2
82-MW-10	27.8
82-MW-11	8.0
82-M2-11 Dup	8.0
WP030 II	14.0
WP030 II T.V.	14.0

? ? Need?

Sample	mg/L TOC
71-CPT-GEO Depth 1	2.3
71-17CPT-GEO Depth 1	3.6
71-17CPT-GEO Depth 2	2.1
71-18CPT-GEO Depth 2	1.6
71-19CPT-GEO Depth 1	5.4
71-29CPT-GEO Depth 1	2.7
71-29CPT-GEO Depth 2	1.9
71-29CPT-GEO Depth 2 Dup	2.0
WP030 I	8.7
71-31CPT-GEO Depth 1	2.7
71-31CPT-GEO Depth 2	1.9
71-38CPT-GEO Depth 1	3.3
71-38CPT-GEO Depth 1 Dup	3.3
WP030 I	8.5
71-8CPT-GEO Depth 1	8.0
71-23CPT-GEO Depth 1	2.1
71-39CPT-GEO Depth 1	2.8
71-39CPT-GEO Depth 1 Dup	2.9
WP030 I	8.7

True Value of WP030 I = 8.6

MANTECH ENVIRONMENTAL TECHNOLOGY

Ref: 93-PR12/vg
93-MW13/vg

August 26, 1993

Dr. Don Kampbell
R.S. Kerr Environmental Research Lab
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

THRU: S.A. Vandegrift SAV

Dear Don:

Attached are the results of 10 microcosm samples submitted to ManTech Environmental as part of Service Request #SF-0-5. The samples were received on August 24, 1993, and analyzed immediately. The methods used for analysis were EPA methods 350.1, 353.1, and 365.1 and Water's capillary electrophoresis method N-601. Blanks, spikes, duplicates, and known AQC samples were analyzed along with the samples for quality assurance.

If you have any questions concerning these results, please feel free to contact us.

Sincerely,

Priscilla Rhynes

Priscilla Rhynes

Mark White

Mark White

xc: R.L. Cosby
J.L. Seeley
J.T. Wilson

Sample	mg/l $NO_2^- + NO_3^-(N)$	mg/l $NH_3(N)$	mg/l T-P	mg/l Cl^-	mg/l SO_4^{-2}
82-A	.14	<.05	.14	170	66.4
82-B	.25	<.05	.08	163	76.9
82-C	.13	<.05	.24	164	49.9
82-C Dup			.20	161	
82-D	.53	.07	.35	198	193
82-D Dup	.53	.05			
82-E	4.40	<.05	<.05	77.1	39.6
82-E Dup				78.3	39.8
82-F	7.41	<.05	<.05	68.5	63.9
82-F Rep	7.46	<.05	<.05	71.8	67.9
82-H	2.12	<.05	<.05	136	59.7
MW-10	9.16	<.05	6.26	44.7	63.2
MW-11	.36	.25	3.77	48.7	97.6
AQC	7.00	9.85	2.93	176	39.6
True Value	7.10	9.80	3.20	172	42.0
Spike Rec.	102%	103%	97%	92%	103%

31.

MANAGEMENT TECHNOLOGY

Ref: 93-DK4/vg

September 1, 1993

Dr. Don Kampbell
R.S. Kerr Environmental Research Lab
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

THRU: S.A. Vandegrift SAV

Dear Don:

Please find attached results of GC/MSD analysis of Hill AFB core extracts for quantitation of Benzene, Toluene, Ethylbenzene (EB), p-Xylene, m-Xylene, o-Xylene, 1,3,5-Trimethylbenzene (1,3,5-TMB), 1,2,4-Trimethylbenzene (1,2,4-TMB) and 1,2,3-Trimethylbenzene (1,2,3-TMB) as requested under Service Request #SF-0-5.

The analytical method was a modification of RSKSOP-124. Cool (38°C) on-column injection (0.5 µl) was used with electronic pressure control (EPC) set for a constant flow of 0.9 ml/min. A 30M X 0.25 mm Restek Stabilwax (Crossbonded Carbowax-PEG, 0.5 µm film) capillary GC column with 1 foot long X 0.53 mm ID uncoated capillary precolumn was used. Quantification was based on two standard curves: A low level curve was used for extract concentrations in the range 0.01-1.0 µg/ml (0.01,0.1,1.0 µg/ml). The second curve was used for quantification of concentrations >1.0 (1,10,100,333 µg/ml).

If you require further information, please feel free to contact me.

Sincerely,

David A. Kovacs

David A. Kovacs

xc: R.L. Cosby
G. Smith
J.L. Seeley jls

22.

SR#SF-0-5 . .Kampbell | Hill AFB Core Extracts GC/MSD Analyses | Units = mg/kg

:AMPLE NAME	BENZENE	TOLUENE	EB	p-XYLENE	m-XYLENE	o-XYLENE	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB
1 µg/ml	9.06E-01	1.00E+00	1.07E+00	1.05E+00	1.06E+00	1.09E+00	1.10E+00	1.09E+00	1.07E+00
82A-1	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-2	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-3	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-4	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-5	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-6	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-7	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-8	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-9	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-10	ND	ND	ND	ND	ND	ND	ND	ND	ND
10 µg/ml	1.06E+01	1.04E+01	1.04E+01	1.03E+01	1.05E+01	1.05E+01	1.05E+01	1.05E+01	1.05E+01
1 µg/ml	1.07E+00	1.02E+00	1.02E+00	1.02E+00	1.02E+00	1.02E+00	1.02E+00	1.02E+00	1.02E+00
82A-11	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-12	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-13	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-14	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-15	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-16	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-17	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-18	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-19	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-20	ND	ND	ND	ND	ND	ND	ND	ND	ND
100 µg/ml	1.05E+02	1.06E+02	1.07E+02	1.08E+02	1.06E+02	1.06E+02	1.06E+02	1.07E+02	1.07E+02
00 µg/ml QC	9.72E+01	9.35E+01	9.28E+01	9.29E+01	9.19E+01	9.19E+01	9.18E+01	9.23E+01	9.20E+01
82A-21	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-22	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-23	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-24	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-25	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-26	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-27	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-28	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-29	ND	ND	ND	ND	ND	ND	ND	ND	ND

Analyst: David A. Kovacs | BLQ < 0.01 µg/ml | Printed: 9/1/93

Soil · 82-X

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AMPLE NAME	BENZENE	TOLUENE	EB	p-XYLENE	m-XYLENE	o-XYLENE	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB
82A-30	ND	ND	ND	ND	ND	ND	ND	ND	ND
MeCl2	BLQ	BLQ	BLQ	ND	BLQ	BLQ	BLQ	BLQ	ND
0.1 µg/ml	1.08E-01	9.95E-02	1.01E-01	9.94E-02	9.81E-02	1.02E-01	1.01E-01	1.01E-01	1.03E-01
0.01 µg/ml	1.11E-02	9.74E-03	1.04E-02	1.02E-02	1.01E-02	1.09E-02	1.28E-02	1.05E-02	1.22E-02
1 µg/ml	9.62E-01	9.30E-01	9.20E-01	9.10E-01	9.13E-01	9.35E-01	9.33E-01	9.17E-01	9.23E-01
82A-31	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-32	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-33	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-34	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-35	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-36	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-37	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-38	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-39	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-40	ND	ND	ND	ND	ND	ND	ND	ND	ND
100 µg/ml	1.04E+02	1.06E+02	1.06E+02	1.06E+02	1.06E+02	1.06E+02	1.06E+02	1.06E+02	1.06E+02
10 µg/ml QC	9.56E+00	9.35E+00	9.51E+00	9.19E+00	9.39E+00	9.42E+00	9.36E+00	9.41E+00	9.44E+00
82A-41	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-42	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-43	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-44	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-45	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-46	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-47	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-48	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-49	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-50	ND	ND	ND	ND	ND	ND	ND	ND	ND
1 µg/ml	1.04E+00	1.04E+00	1.05E+00	1.06E+00	1.06E+00	1.04E+00	1.05E+00	1.04E+00	1.04E+00
0.1 µg/ml	1.18E-01	1.11E-01	1.10E-01	1.11E-01	1.11E-01	1.10E-01	1.12E-01	1.12E-01	1.13E-01
82A-51	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-52	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-53	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-54	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-55	ND	ND	ND	ND	ND	ND	ND	ND	ND

Analyst: David A. Kovacs   BLQ < 0.01 µg/ml

94.

SR#SF-0-5 Dr. Kampbell | Hill AFB Core Extracts GC/MSD Analyses | Units = mg/kg

SAMPLE NAME	BENZENE	TOLUENE	EB	p-XYLENE	m-XYLENE	o-XYLENE	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB
82B-1	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-2	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-3	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-4	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-5	ND	ND	ND	ND	ND	ND	ND	ND	ND
0.01 µg/ml	1.31E-02	1.10E-02	1.13E-02	1.14E-02	1.13E-02	1.08E-02	1.35E-02	1.11E-02	1.25E-02
0.1 µg/ml	8.94E-02	9.36E-02	9.41E-02	9.38E-02	9.38E-02	9.45E-02	9.29E-02	9.34E-02	9.22E-02
1 µg/ml	9.58E-01	9.60E-01	9.47E-01	9.38E-01	9.38E-01	9.59E-01	9.46E-01	9.56E-01	9.63E-0
10 µg/ml QC	9.25E+00	9.52E+00	1.00E+01	9.36E+00	9.51E+00	9.75E+00	9.30E+00	9.34E+00	9.52E+00
1 µg/ml	9.17E-01	9.92E-01	1.02E+00	1.02E+00	1.02E+00	1.03E+00	1.03E+00	1.04E+00	1.04E+00
82B-6	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-7	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-8	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-9	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-10	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-11	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-12	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-13	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-14	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-15	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-16	ND	ND	ND	ND	ND	ND	ND	ND	ND
MeCl2	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	ND
0.1 µg/ml	1.02E-01	1.03E-01	1.04E-01	1.05E-01	1.05E-01	1.05E-01	1.04E-01	1.05E-01	1.04E-01
1 µg/ml	9.37E-01	9.76E-01	9.64E-01	9.70E-01	9.69E-01	9.62E-01	9.43E-01	9.54E-01	9.56E-01
82B-17	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-18	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-19	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-20	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-21	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-22	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-23	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-24	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-25	ND	ND	ND	ND	ND	ND	ND	ND	ND
82C-14	ND	ND	ND	ND	ND	ND	ND	ND	ND

Analyst: David A. Kovacs | BLQ < 0.01 µg/ml | Printed: 9/1/93

SR# SF-0-6 Dr. Kampbell | Hill AFB Core Extracts GC/MSD Analyses | Units = mg/kg

25.

SAMPLE NAME	BENZENE	TOLUENE	EB	p-XYLENE	m-XYLENE	o-XYLENE	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB
82C-16	ND	ND	ND	ND	ND	ND	1.39E-02	1.67E-02	4.91E-03
10 µg/ml QC	9.52E+00	9.62E+00	1.00E+01	9.34E+00	9.53E+00	9.77E+00	9.41E+00	9.54E+00	9.76E+00
100 µg/ml	9.87E+01	1.03E+02	1.03E+02	1.05E+02	1.03E+02	1.03E+02	1.04E+02	1.04E+02	1.04E+02
82C-19	6.21E-03	BLQ	1.80E-02	4.20E-02	2.57E-02	1.51E-02	1.65E+00	1.16E+00	1.08E-01
82C-20	BLQ	1.76E-02	6.18E-03	2.96E-02	9.10E-03	4.01E-03	1.50E+00	1.03E+00	5.53E-02
82C-21	3.67E-03	1.92E-02	5.58E-03	3.65E-02	9.56E-03	BLQ	2.34E+00	2.04E+00	2.08E-01
82C-22	3.27E-03	2.00E-02	2.86E-02	8.57E-02	6.62E-02	BLQ	3.70E+00	4.42E+00	9.05E-01
82C-23	BLQ	BLQ	6.42E-03	1.10E-02	9.91E-03	BLQ	8.01E-02	7.41E-02	8.13E-03
82C-24	BLQ	BLQ	7.95E-03	1.05E-02	1.89E-02	BLQ	1.48E-02	1.68E-02	3.63E-03
82C-25	BLQ	BLQ	1.24E-02	2.21E-02	5.21E-02	1.36E-02	3.88E-02	5.40E-02	2.29E-02
82C-26	BLQ	BLQ	1.18E-02	1.78E-02	4.18E-02	7.16E-03	2.90E-02	3.71E-02	1.45E-02
82D-1	9.59E-03	BLQ	1.59E-02	BLQ	BLQ	BLQ	4.16E-03	BLQ	BLQ
82D-3	ND	BLQ	3.35E-03	BLQ	3.36E-03	BLQ	1.74E-02	8.85E-03	3.11E-03
82D-4	BLQ	BLQ	8.71E-03	1.36E-02	3.45E-02	4.51E-03	1.95E-01	2.25E-01	6.48E-02
MeCl2	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
Method Blank	ND	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
0.01 µg/ml	1.02E-02	9.59E-03	1.00E-02	1.02E-02	1.02E-02	9.83E-03	1.11E-02	1.02E-02	1.15E-02
0.1 µg/ml	9.87E-02	9.93E-02	9.87E-02	9.88E-02	9.86E-02	9.86E-02	9.85E-02	9.66E-02	9.52E-02
1 µg/ml	1.09E+00	1.01E+00	1.00E+00	1.00E+00	9.98E-01	9.95E-01	9.88E-01	9.91E-01	9.83E-01
82D-5	BLQ	BLQ	ND	BLQ	BLQ	BLQ	BLQ	4.98E-03	BLQ
82D-6	BLQ	BLQ	ND	ND	ND	ND	ND	ND	ND
82D-12	2.03E-02	BLQ	1.15E-01	4.54E-03	1.67E-02	BLQ	6.32E-03	4.16E-03	BLQ
82D-13	1.85E-02	BLQ	1.41E-01	7.55E-03	2.75E-02	4.76E-03	8.71E-03	5.72E-03	BLQ
82D-14	2.09E-02	BLQ	1.24E-01	6.62E-02	1.94E-02	BLQ	6.37E-02	6.95E-02	5.18E-03
82D-15	3.43E-02	BLQ	8.78E-02	3.90E-02	1.21E-01	3.23E-02	4.33E-02	3.03E-02	1.27E-02
82D-16	3.16E-02	3.04E-03	6.13E-02	5.51E-02	1.81E-01	4.50E-02	3.65E-02	3.99E-02	2.13E-02
82D-17	6.30E-03	BLQ	2.13E-02	BLQ	BLQ	BLQ	1.47E-02	BLQ	ND
82D-18	7.92E-03	BLQ	3.44E-02	BLQ	BLQ	BLQ	2.58E-02	BLQ	ND
100 µg/ml	1.13E+02	1.08E+02	1.08E+02	1.08E+02	1.08E+02	1.08E+02	1.09E+02	1.09E+02	1.09E+02
10 µg/ml	1.10E+01	9.98E+00	9.96E+00	9.98E+00	1.00E+01	1.00E+01	1.00E+01	9.86E+00	9.95E+00
82D-19	8.29E-03	BLQ	6.04E-02	3.88E-02	5.29E-03	5.77E-03	8.82E-02	7.80E-02	8.21E-03
82D-21	1.04E-02	BLQ	9.49E-02	BLQ	3.03E-03	BLQ	4.77E-03	3.10E-03	ND
82D-22	6.97E-02	BLQ	1.11E-01	1.30E-02	BLQ	BLQ	3.04E-02	1.11E-02	BLQ
82D-23	2.71E-01	BLQ	1.48E+00	1.62E+00	3.40E+00	7.32E-01	2.53E+00	3.11E+00	8.17E-01

Analyst: David A. Kovacs | BLQ < 0.01 µg/ml | Printed: 9/1/93

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SR#SF-0-. .. Kampbell   Hill AFB Core Extracts ..MSD Analyses   Units = mg...

SAMPLE NAME	BENZENE	TOLUENE	EB	p-XYLENE	m-XYLENE	o-XYLENE	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB
82D-24	1.29E-01	BLQ	2.64E-01	2.76E-01	5.55E-01	1.44E-01	3.73E-01	4.40E-01	1.35E-01
82D-25	1.03E-02	BLQ	1.06E-02	5.75E-03	1.43E-02	3.59E-03	7.44E-03	7.02E-03	BLQ
82D-38	3.93E-02	8.09E-03	1.28E-01	1.05E-02	1.01E-01	6.92E-02	7.33E-02	1.07E-02	3.84E-02
82D-39	3.88E-02	BLQ	1.37E-01	BLQ	4.04E-03	4.86E-03	7.70E-03	BLQ	BLQ
82D-40	3.14E-02	BLQ	1.71E-01	3.78E-02	1.11E-01	2.42E-02	4.39E-02	3.73E-02	1.63E-02
82E-2	ND	ND	ND	ND	ND	ND	ND	ND	ND
1 µg/ml	1.05E+00	1.02E+00	9.94E-01	9.85E-01	9.93E-01	9.93E-01	1.02E+00	9.89E-01	1.00E+00
0.1 µg/ml	1.08E-01	1.03E-01	1.02E-01	1.01E-01	1.01E-01	9.99E-02	1.00E-01	9.91E-02	9.93E-02
82E-3	ND	ND	ND	ND	ND	ND	ND	ND	ND
82E-13	ND	ND	ND	ND	ND	ND	ND	ND	ND
82E-14	ND	ND	ND	ND	ND	ND	ND	ND	ND
82E-15	ND	ND	ND	ND	ND	ND	ND	ND	ND
82E-17	ND	ND	ND	ND	ND	ND	ND	ND	ND
82I-5	1.61E+00	2.04E-01	1.12E+01	2.34E+01	6.31E+01	1.99E+01	2.93E+01	6.09E+01	1.93E+01
MeCl2	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
333 µg/ml	3.49E+02	3.45E+02	3.44E+02	3.56E+02	3.45E+02	3.44E+02	3.43E+02	3.43E+02	3.42E+02
82I-15	5.01E-01	1.07E+00	3.72E+00	4.81E+00	1.05E+01	5.58E+00	2.94E+00	8.45E+00	2.03E+00
82I-16	3.33E-01	3.04E-01	1.12E+00	1.48E+00	1.83E+00	1.72E+00	8.57E-01	2.33E+00	6.72E-01
82I-17	6.53E-01	5.91E-01	3.39E+00	4.69E+00	4.89E+00	5.28E+00	3.04E+00	8.37E+00	2.34E+00
82I-18	6.29E-01	1.17E-01	1.31E+00	2.02E+00	9.88E-01	2.31E+00	1.62E+00	4.72E+00	1.25E+00
10 µg/ml QC	1.03E+01	9.15E+00	9.45E+00	8.67E+00	9.02E+00	9.17E+00	8.89E+00	9.01E+00	9.23E+00
100 µg/ml	1.00E+02	9.47E+01	9.40E+01	9.08E+01	9.39E+01	9.40E+01	9.51E+01	9.50E+01	9.50E+01
10 µg/ml	9.74E+00	9.81E+00	9.76E+00	1.02E+01	9.99E+00	1.00E+01	1.03E+01	1.02E+01	1.01E+01
1 µg/ml	9.89E-01	1.02E+00	1.02E+00	1.00E+00	1.01E+00	1.01E+00	1.08E+00	1.02E+00	1.01E+00
82I-19	6.78E-01	4.55E-02	1.60E-01	2.43E-01	5.17E-01	3.16E-01	8.43E-02	2.22E-01	7.78E-02
82I-20	5.38E-01	4.36E-02	1.52E-01	2.21E-01	6.04E-01	3.03E-01	7.47E-02	1.91E-01	7.09E-02
82I-21	6.65E-01	3.50E-02	1.59E-01	2.33E-01	6.12E-01	3.21E-01	7.96E-02	2.06E-01	7.83E-02
82I-22	7.71E-01	9.36E-02	1.50E-01	2.33E-01	6.21E-01	3.18E-01	9.38E-02	2.46E-01	8.99E-02
82I-23	1.45E+00	2.00E-01	2.83E-01	4.27E-01	1.16E+00	5.67E-01	1.57E-01	4.02E-01	1.55E-01
82I-24	7.87E-01	1.59E-01	1.50E-01	2.28E-01	6.16E-01	3.10E-01	7.43E-02	1.95E-01	7.49E-02
82I-25	8.66E-01	2.31E-01	1.87E-01	2.81E-01	8.02E-01	4.03E-01	1.03E-01	2.44E-01	9.09E-02
82I-26	7.49E-01	3.75E+00	1.03E+00	1.70E+00	4.74E+00	2.04E+00	1.24E+00	2.54E+00	9.58E-01
82I-27	4.90E-01	1.73E+00	3.77E-01	6.25E-01	1.84E+00	7.25E-01	3.84E-01	7.24E-01	2.72E-01
82I-28	BLQ	1.68E-02	BLQ	BLQ	8.84E-03	BLQ	BLQ	5.24E-03	BLQ

Analyst: David A. Kovacs   BLQ < 0.01 µg/ml

27.

SR# SF-0-5 Dr. Kampbell

Hill AFB Core Extracts GC/MSD Analyses

Units = mg/kg

SAMPLE NAME	BENZENE	TOLUENE	EB	p-XYLENE	m-XYLENE	o-XYLENE	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB
1 µg/ml	1.01E+00	1.05E+00	1.02E+00	1.01E+00	1.01E+00	1.03E+00	1.08E+00	1.04E+00	1.01E+00
0.1 µg/ml	1.05E-01	1.03E-01	9.81E-02	9.95E-02	9.92E-02	9.70E-02	9.35E-02	9.11E-02	9.53E-02
821-29	BLQ	1.57E-02	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
821-30	BLQ	1.11E-02	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
821-31	BLQ	1.14E-02	1.01E-01	ND	1.28E-02	BLQ	4.18E-01	1.91E-02	2.59E-01
821-32	1.36E-02	3.20E-02	1.24E+00	1.05E+00	1.79E+00	3.76E-02	1.31E+01	7.62E+00	3.09E+00
821-33	BLQ	1.22E-02	2.71E+01	ND	ND	ND	BLQ	BLQ	ND
821-34	BLQ	7.30E-03	1.61E+01	ND	ND	ND	ND	ND	ND
821-35	8.31E-03	1.37E-02	BLQ	BLQ	ND	BLQ	BLQ	BLQ	ND
821-36	8.12E-02	1.54E-02	2.38E-02	3.64E-02	8.98E-02	8.50E-02	1.21E-02	1.72E-02	9.37E-03
821-37	7.12E-01	1.82E-01	2.72E+00	3.96E+00	7.86E+00	4.79E+00	2.32E+00	5.38E+00	1.50E+00
821-38	3.15E-01	1.88E-02	1.21E-01	1.54E-01	5.92E-02	1.29E-01	3.10E-02	1.13E-01	3.10E-02
821-39	4.22E-01	6.74E-02	1.31E+00	1.75E+00	2.28E+00	1.03E+00	1.27E+00	3.30E+00	8.23E-01
MeCl2	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
Method Blank	ND	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
10 µg/ml QC	1.06E+01	1.06E+01	1.08E+01	1.04E+01	1.06E+01	1.06E+01	1.04E+01	1.05E+01	1.06E+01
100 µg/ml	1.07E+02	1.04E+02	1.04E+02	1.03E+02	1.04E+02	1.04E+02	1.04E+02	1.04E+02	1.04E+02

Analyst: David A. Kovacs

BLQ < 0.01 µg/ml

 Printed: 9/1/93

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MANTECH

Ref: 93-DK8/vg

October 21, 1993

Dr. John T. Wilson
R.S. Kerr Environmental Research Lab
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

THRU: S.A. Vandegrift SAV

Dear John:

Please find attached results of GC/MSD analysis of Hill AFB core extracts for quantitation of Benzene, Toluene, Ethylbenzene (EB), p-Xylene, m-Xylene, o-Xylene, 1,3,5-Trimethylbenzene (1,3,5-TMB), 1,2,4-Trimethylbenzene (1,2,4-TMB) and 1,2,3-Trimethylbenzene (1,2,3-TMB) as requested under Service Request #SF-0-26.

The analytical method was a modification of RSKSOP-124. Cool (38°C) on-column injection (0.5 μl) was used with electronic pressure control (EPC) set for a constant flow of 0.9 ml/min. A 30M X 0.25 mm Restek Stabilwax (Crossbonded Carbowax-PEG, 0.5 μm film) capillary GC column with 1 foot long X 0.53 mm ID uncoated capillary precolumn was used. Quantification was based on two standard curves: A low level curve was used for extract concentrations in the range 0.01-1.0 μg/ml (0.01, 0.1, 1.0 μg/ml). The second curve was used for quantification of concentrations >1.0 (1, 10, 100 μg/ml).

If you require further information, please feel free to contact me.

Sincerely,

David A. Kovacs

David A. Kovacs

xc: R.L. Cosby
J.L. Seeley
G. Smith

ManTech Environmental Technology, Inc.

P.O. Box 12313, 2 Triangle Drive, Research Triangle Park, North Carolina 27709 919-549-0611 FAX 919-549-4665

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Servic. Request SF-0-26 Dr. Wilson HIll AFB Core Extrac.. GC/MSD Analyses Units = mg/kg

SAMPLE	BENZENE	TOLUENE	EB	p-XYLENE	m-XYLENE	o-XYLENE	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB
100 µg/ml QC	9.78E+01	9.29E+01	9.24E+01	9.39E+01	9.22E+01	9.22E+01	9.40E+01	9.19E+01	9.15[illegible]
1 µg/ml	1.05E+00	1.06E+00	1.03E+00	1.03E+00	1.03E+00	1.03E+00	1.06E+00	1.03E+00	1.07E+00
82I-1	BLQ	1.42E-01	5.56E-01	1.22E+00	3.67E+00	1.61E+00	2.30E+00	4.43E+00	1.71E+00
82I-2	4.01E-01	1.26E+01	1.75E+01	3.44E+01	9.93E+01	3.66E+01	3.68E+01	6.98E+01	2.53E+01
82I-3	4.55E+00	2.73E+00	4.77E+01	1.05E+02	2.94E+02	1.00E+02	8.88E+01	1.67E+02	5.92E+01
82I-4	5.17E-01	2.35E-01	4.83E+00	2.23E+01	6.23E+01	2.08E+01	2.33E+01	4.27E+01	1.54E+01
82I-5	3.26E-02	2.66E-02	1.45E+01	1.99E+01	5.27E+01	1.82E+01	2.81E+01	4.99E+01	1.85E+01
82I-6	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
82I-7	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
82I-8	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	ND
82I-9	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
82I-10	ND	BLQ	BLQ	BLQ	4.08E-03	BLQ	BLQ	BLQ	BLQ
1 µg/ml	9.73E-01	1.06E+00	1.06E+00	1.06E+00	1.05E+00	1.05E+00	1.06E+00	1.08E+00	1.07E+00
0.1 µg/ml	1.04E-01	1.04E-01	9.74E-02	9.63E-02	9.86E-02	9.93E-02	1.01E-01	1.04E-01	1.09E-01
82I-11	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
82I-12	BLQ	BLQ	BLQ	BLQ	5.43E-03	BLQ	BLQ	BLQ	BLQ
82I-13	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	ND
82I-14	ND	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
Method Blank	ND	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
1 µg/ml	1.05E+00	1.06E+00	1.03E+00	1.03E+00	1.03E+00	1.03E+00	1.06E+00	1.03E+00	1.07E+00

Analyst: David A. Kovacs BLQ < 0.01 µg/ml Page 1 of 1 Printed: 10/21/93

3C.

MANTECH ENVIRONMENTAL TECHNOLOGY

Ref: 93-RC16/vg

October 20, 1993

Dr. John Wilson
R.S. Kerr Environmental Research Lab
U.S. Environmental Protection Agency
Post Office Box 1198
Ada, OK 74820

THRU: S.A. Vandegrift SAV

Dear John:

Attached is a report of the data generated from the analyses of 14 sample core extracts from Hill AFB, UT. The extracts, which were submitted under Service Request #SF-0-26, were analyzed for total fuel content as JP-4 jet fuel only. The reported values for fuel carbon were computed from the JP-4 determinations. I have also attached a report of the quality control analyses that were performed concurrently with the sample analyses.

Data quantification, peak identification, component concentration calculations, and dilution factor corrections were performed by MAXIMA chromatography software. JP-4 data was quantified with a 7-point external standard calibration curve ranging from 50 - 50,000 ng/µl.

The Minimum Detectable Limit (MDL) for JP-4 is determined by the concentration of the lowest calibration standard, which is 50 ng/µl. Since the MDL is determined by a calibration standard, it may also be defined as the Minimum Quantifiable Limit (MQL). It is important to note that values less than the MQL are reported in this data set, but cannot be considered quantified since they lie outside the range of the standard curve. All such unquantified data are approximations extrapolated from the JP-4 standard curve.

The samples from Service Request #SF-0-26 had an average mass of 15.23 g, and were extracted with 5.0 ml of methylene chloride. For simplicity's sake, I have assumed complete extraction of the sample's contents into the 5.0 ml of solvent.

In order to compute the MQL of JP-4 in the average sample core, assume the following:

Sample mass = 15.23 g
Extract volume = 5.0 ml
Extraction efficiency = 100%
Determined mass of JP-4 = 50 ng
(in 1.0 µl of extract)

ManTech Environmental Technology, Inc.

P.O. Box 12313, 2 Triangle Drive, Research Triangle Park, North Carolina 27709 919-549-0611 FAX 919-549-4665

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Computation of the total mass of JP-4 in 5.0 ml of extract is as follows:

$$1.\quad \left(\frac{50\ \cancel{ng}}{1.0\ \cancel{\mu l}}\right)\left(\frac{1000\ \cancel{\mu l}}{\cancel{ml}}\right)\left(\frac{1\ \mu g}{1000\ \cancel{ng}}\right)\ \underline{5.0\ \cancel{ml}} = 250\ \mu g$$

Consider that 22.28 g of sample was extracted with the 5.0 ml aliquot of methylene chloride and the original concentration is computed by division of the extracted mass of JP-4 by the sample mass:

$$2.\quad \frac{250\ \mu g}{15.23\ g} = 16.41\ \mu g/g$$

Therefore, 16.41 µg/g (or mg/kg, or ppm if you prefer either of these units) is the Minimum Quantifiable Limit (MQL) of JP-4 determined in these samples.

It should be realized that JP-4 determinations are based on the summation of multiple peak areas detected over a defined period of time rather than the area of a specific peak, which is typical of individual fuel component determinations. When using this method of determination, it is entirely possible for a single peak or a group of peaks not attributable to JP-4 to register enough area to be mistakenly represented as JP-4.

Sample extracts were received from Mark Blankenship on October 15, 1993. Analyses were started on October 18, 1993, and concluded on October 19, 1993. Sample extracts and quality control samples were analyzed according to RSKSOP-72, Rev. No. 1, excepting the modifications listed in the attached outline.

If you have any questions concerning this report, please contact me at your convenience.

Sincerely,

Randy Callaway

Randy Callaway

xc: R.L. Cosby
J.L. Seeley

32.1

SR#SF-0-26 / Wilson / Hi(\FB all conc. are ug/g

Sample I.D.	Dilution Factor	JP-4	Fuel Carbon (JP-4 x 0.85)
82 I1	1	398.00	338.00
82 I2	1	5870.00	4990.00
82 I3	10	14800.00	12600.00
82 I4	1	3770.00	3200.00
82 I5	1	4330.00	3680.00
82 I6	1	30.40	25.80
82 I7	1	2.35	2.00
82 I8	1	0.73	0.62
82 I9	1	0.84	0.72
82 I10	1	0.86	0.73
82 I11	1	0.83	0.71
82 I12	1	0.88	0.75
82 I13	1	1.24	1.05
82 I14	1	0.98	0.83

NOTE: all reported values are corrected for dilution factors where applicable

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SR#SF-0-26 / Wilson / QC 1 all conc. are ng/ul

Sample I.D.	Date	JP-4
blk MeCl2	18OCT93	1.70
Method blank		2.21
500 jp4		[illegible]0.00
5000 jp4		4[illegible].00
50000 jp4		47400.00
blk MeCl2	21OCT93	2.96
1000 jp4		976.00
10000 jp4		9130.00

blk MeCl2 = methylene chloride solvent blank
jp4 = JP-4 fuel standard (ng/ul)

34.

I. HP5890 GC OPERATING CONDITIONS

- A. Instrument Control
  - 1. Analyses: "SH-2-JP4"
  - 2. Program: "RWC-AS10"
  - 3. Calibration: "DK-5-BTEX"
- B. Temperature Program
  - 1. Initial Temp & Time: 10°C for 3.00 min
  - 2. Level 1: Rate = 4°C/min to 70°C, Final Time = 0.00
  - 3. Level 2: Rate = 10°C/min to 270°C, Final Time = 2.00
  - 4. Run Time: 40.00 min
  - 5. Oven Equilibration Time: 1.00 min
- C. Miscellaneous
  - 1. Peak Width: 0.02
  - 2. Attentuation: 2^5
  - 3. Chart Speed: 0.50
  - 4. Threshold = 0
  - 5. Offset = 10%

II. MAXIMA PEAK INTEGRATION

- A. Peak Detection Parameters
  - 1. Baseline Points: 18
  - 2. Filter Window (in points): 13
  - 3. Intg. Sensitivity (coarse): 5.00 μV/sec
  - 4. Intg. Sensitivity (fine): 5.00 μV/sec
- B. Peak Rejection Criteria
  - 1. Minimum Area: 2000 μV-sec
  - 2. Minimum Height: 300.0 μV
  - 3. Minimum Width: 3.00 sec
- C. Integration Events
  - 1. 0.00: Disable Peak Skimming
  - 2. 0.00: Disable Peak Detection
  - 3. 5.00: Enable Peak Detection
  - 4. 19.96: Set Baseline
  - 5. 21.74: Set Baseline
  - 6. 23.23: Set Baseline
  - 7. 26.20: Set Baseline
  - 8. 27.58: Set Baseline
  - 9. 28.66: Set Baseline
  - 10. 30.20: Set Baseline
  - 11. 32.81: Set Baseline

IV. MAXIMA DATA ACQUISITION

- A. Preacquisition Delay: 5.00 min
- B. Duration: 35.00 min
- C. Rate: 3.00 points/sec
- D. Run Time: 40.00 min

V. MAXIMA CALIBRATION CURVES

- A. JP-4
  - 1. Calibration Range = 50 - 50,000 ng/μl
  - 2. Summation of all peaks detected from 5.00 - 40.00 minutes

35'

SOIL
OVM/JP4/TPH

Hill AFB Field Data Number 2		
Sample	Depth (ft)	OVM
82 I-14 TO 82 I-8	13.8-16.28	2
82 I-7	16.28-16.64	13
82 I-6	16.64-17.00	81
8a I-5	17.0-17.36	257
82 I-4	17.36-1772	181
82 I-3	17.72-1808	137
82 I-2	1808-18.44	150
82 I-1	18.44-18.80	143
82 I-27	18.8-19.12	397
82 I-26	19.12-19.45	301
82 I-25	19.45-19.77	136
82 I-24	19.77-20.09	176
82 I-23	20.09-20.42	78
82 I-22	20.42-20.74	87
82 I-21 TO 82 I-19	20.74-21.71	92.33
82 I-18	21.71-22.03	298
82 I-17	22.03-22.35	357
82 I-16	22.35-22.68	293
82 I-15	22.68-23.00	270
82 I-39	23.0-23.2	255
82 I-38	23.2-23.4	145
82 I-37	23.4-23.76	330
82 I-36	23.76-24.12	239
82 I-35	24.12-24.48	74
82 I-34	24.48-24.89	68
82 I-33	24.89-25.20	311
82 I-32	25.20-25.56	236
82 I-31	25.56-25.92	249
82 I-30 TO 82 I-28	25.92-27.00	84

36.

Hill AFB Field Data Number 2		
Sample	Depth (ft)	JP-4 (mg/kg)
82 I-14 TO 82 I-8	13.8-16.28	1.2 to 0.73
82 I-7	16.28-16.64	2.4
82 I-6	16.64-17.00	30.4
8a I-5	17.0-17.36	5330 and 4330
82 I-4	17.36-17.72	3770
82 I-3	17.72-18.08	14800
82 I-2	18.08-18.44	5870
82 I-1	18.44-18.80	398
82 I-27	18.8-19.12	67.30
82 I-26	19.12-19.45	276.00
82 I-25	19.45-19.77	17.60
82 I-24	19.77-20.09	14.30
82 I-23	20.09-20.42	24.00
82 I-22	20.42-20.74	17.90
82 I-21 TO 82 I-19	20.74-21.71	12.96
82 I-18	21.71-22.03	720.00
82 I-17	22.03-22.35	1290.00
82 I-16	22.35-22.68	385.00
82 I-15	22.68-23.00	1190.00
82 I-39	23.0-23.2	485.00
82 I-38	23.2-23.4	8.06
82 I-37	23.4-23.76	1370.00
82 I-36	23.76-24.12	4.20
82 I-35	24.12-24.48	4.96
82 I-34	24.48-24.89	2.87
82 I-33	24.89-25.20	4.43
82 I-32	25.20-25.56	3830.00
82 I-31	25.56-25.92	834.00
82 I-30 TO 82 I-28	25.92-27.00	5.96

37.

Hill AFB Field Data Number 2		
Sample	Depth (ft)	TPH (mg/kg)
82 I-14 TO 82 I-8	13.8-16.28	<10
82 I-7	16.28-16.64	138
82 I-6	16.64-17.00	139
8a I-5	17.0-17.36	3530
82 I-4	17.36-17.72	11500
82 I-3	17.72-18.08	28300
82 I-2	18.08-18.44	5160
82 I-1	18.44-18.80	6080
82 I-27	18.8-19.12	<10
82 I-26	19.12-19.45	<10
82 I-25	19.45-19.77	<10
82 I-24	19.77-20.09	<10
82 I-23	20.09-20.42	<10
82 I-22	20.42-20.74	<10
82 I-21 TO 82 I-19	20.74-21.71	<10
82 I-18	21.71-22.03	276
82 I-17	22.03-22.35	856±80
82 I-16	22.35-22.68	<10
82 I-15	22.68-23.00	643
82 I-39	23.0-23.2	<10
82 I-38	23.2-23.4	<10
82 I-37	23.4-23.76	340
82 I-36	23.76-24.12	<10
82 I-35	24.12-24.48	<10
82 I-34	24.48-24.89	<10
82 I-33	24.89-25.20	<10
82 I-32	25.20-25.56	410±256
82 I-31	25.56-25.92	<10
82 I-30 TO 82 I-28	25.92-27.00	<10

38.

Hill AFB Field Data Number 2		
Sample	Depth (ft)	OVM
82 D-11	20.0-20.3	1
82 D-10	20.3-20.6	1
82 D-9	20.6-20.9	1
82 D-8	20.9-21.2	1
82 D-7	21.2-21.5	1
82 D-6	21.5-21.8	1
82 D-5	21.8-22.1	3
82 D-4	22.1-22.4	139
82 D-3	22.4-22.8	11
82 D-2	22.8-23.2	0
82 D-1	23.2-23.8	0
NS	23.8-24.0	
82 D-25	24.0-24.1	25
82 D-24	24.1-24.4	50
82 D-23	24.4-24.7	282
82 D-22	24.7-25.0	63
82 D-21	25.0-25.3	30
82 D-20	25.3-25.6	16
82 D-19	25.6-25.9	29
82 D-18	25.9-26.2	11
82 D-17	26.2-26.5	15
82 D-16	26.5-26.8	20
82 D-15	26.8-27.0	27
82 D-14	27.0-27.3	20
82 D-13	27.3-27.6	25
82 D-12	27.6-27.8	15
NS	27.8-28.0	
82 D-40	28.0-28.2	
82 D-39	28.2-28.5	
82 D-38	28.5-28.8	

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82 D-37	28.8-29.1	
82 D-36	29.1-29.4	
82 D-35	29.4-29.7	
82 D-34	29.7-30.0	
82 D-33	30.0-30.3	
82 D-32	30.3-30.6	
82 D-31	30.6-30.9	
82 D-30	30.9-31.2	
82 D-29	31.2-31.5	
82 D-28	31.5-31.8	
82 D-27	31.8-32.1	
82 D-26	32.1-32.4	

40.

Hill AFB Field Data Number 2		
Sample	Depth (ft)	JP-4 (mg/kg)
82 D-11	20.0-20.3	
82 D-10	20.3-20.6	
82 D-9	20.6-20.9	
82 D-8	20.9-21.2	
82 D-7	21.2-21.5	
82 D-6	21.5-21.8	0.76
82 D-5	21.8-22.1	0.81
82 D-4	22.1-22.4	79.60
82 D-3	22.4-22.8	1.93
82 D-2	22.8-23.2	
82 D-1	23.2-23.8	1.12
NS	23.8-24.0	
82 D-25	24.0-24.1	1.69
82 D-24	24.1-24.4	77.10
82 D-23	24.4-24.7	572.0
82 D-22	24.7-25.0	2.22
82 D-21	25.0-25.3	1.83
82 D-20	25.3-25.6	
82 D-19	25.6-25.9	2.72
82 D-18	25.9-26.2	1.92
82 D-17	26.2-26.5	0.56
82 D-16	26.5-26.8	2.67
82 D-15	26.8-27.0	2.41
82 D-14	27.0-27.3	3.25
82 D-13	27.3-27.6	3.38
82 D-12	27.6-27.8	3.09
NS	27.8-28.0	
82 D-40	28.0-28.2	6.12
82 D-39	28.2-28.5	4.12

41.

82 D-38	28.5-28.8	3.96
82 D-37	28.8-29.1	
82 D-36	29.1-29.4	
82 D-35	29.4-29.7	
82 D-34	29.7-30.0	
82 D-33	30.0-30.3	
82 D-32	30.3-30.6	
82 D-31	30.6-30.9	
82 D-30	30.9-31.2	
82 D-29	31.2-31.5	
82 D-28	31.5-31.8	
82 D-27	31.8-32.1	
82 D-26	32.1-32.4	

12.

Hill AFB Field Data Number 2		
Sample	Depth (ft)	TPH (ms/kg)
82 D-11	20.0-20.3	
82 D-10	20.3-20.6	
82 D-9	20.6-20.9	
82 D-8	20.9-21.2	
82 D-7	21.2-21.5	
82 D-6	21.5-21.8	
82 D-5	21.8-22.1	<10
82 D-4	22.1-22.4	<10
82 D-3	22.4-22.8	<10
82 D-2	22.8-23.2	<10
82 D-1	23.2-23.8	<10
NS	23.8-24.0	
82 D-25	24.0-24.1	
82 D-24	24.1-24.4	<10
82 D-23	24.4-24.7	<10
82 D-22	24.7-25.0	<10
82 D-21	25.0-25.3	
82 D-20	25.3-25.6	
82 D-19	25.6-25.9	
82 D-18	25.9-26.2	
82 D-17	26.2-26.5	<10
82 D-16	26.5-26.8	<10
82 D-15	26.8-27.0	<10
82 D-14	27.0-27.3	<10
82 D-13	27.3-27.6	
82 D-12	27.6-27.8	
NS	27.8-28.0	
82 D-40	28.0-28.2	
82 D-39	28.2-28.5	

43.

82 D-38	28.5-28.8	
82 D-37	28.8-29.1	
82 D-36	29.1-29.4	
82 D-35	29.4-29.7	
82 D-34	29.7-30.0	
82 D-33	30.0-30.3	
82 D-32	30.3-30.6	
82 D-31	30.6-30.9	
82 D-30	30.9-31.2	
82 D-29	31.2-31.5	
82 D-28	31.5-31.8	
82 D-27	31.8-32.1	
82 D-26	32.1-32.4	

4.

Hill AFB Field Data Number 2		
Sample	Depth (ft)	OVM
82 C-1	14.0	
82 C-2	13.5	
82 C-3	18.1	
82 C-4	17.8	
82 C-5	17.5	
82 C-6	17.2	
82 C-7	16.9	
82 C-8	16.6	
82 C-9	16.3	
82 C-10	16.0	
82 C-11	15.7	
82 C-12	15.4	
82 C-13	22.9	
82 C-14	22.6	
82 C-15	skipped	
82 C-16	22.3	
82 C-17	22.1	
82 C-18	broke	
82 C-19	22.0	
82 C-20	21.7	
82 C-21	21.55	
82 C-22	21.4	
82 C-23	21.1	
82 C-24	20.8	
82 C-25	20.5	
82 C-26	20.2	

Hill AFB Field Data Number 2		
Sample	Depth (ft)	JP-4 (mg/kg)
82 C-1	14.0	
82 C-2	13.5	
82 C-3	18.1	
82 C-4	17.8	
82 C-5	17.5	
82 C-6	17.2	
82 C-7	16.9	
82 C-8	16.6	
82 C-9	16.3	
82 C-10	16.0	
82 C-11	15.7	
82 C-12	15.4	
82 C-13	22.9	
82 C-14	22.6	0.62
82 C-15	skipped	
82 C-16	22.3	1.01
82 C-17	22.1	
82 C-18	broke	
82 C-19	22.0	638.0
82 C-20	21.7	593.0
82 C-21	21.55	698.0
82 C-22	21.4	820.0
82 C-23	21.1	26.0
82 C-24	20.8	1.02
82 C-25	20.5	2.88
82 C-26	20.2	1.95

Hill AFB Field Data Number 2		
Sample	Depth (ft)	TPH (mg/kg)
82 C-1	14.0	
82 C-2	13.5	
82 C-3	18.1	
82 C-4	17.8	
82 C-5	17.5	
82 C-6	17.2	
82 C-7	16.9	
82 C-8	16.6	
82 C-9	16.3	
82 C-10	16.0	
82 C-11	15.7	
82 C-12	15.4	
82 C-13	22.9	
82 C-14	22.6	<10
82 C-15	skipped	
82 C-16	22.3	<10
82 C-17	22.1	<10
82 C-18	broke	
82 C-19	22.0	444
82 C-20	21.7	580±14
82 C-21	21.55	173
82 C-22	21.4	352
82 C-23	21.1	<10
82 C-24	20.8	<10
82 C-25	20.5	<10
82 C-26	20.2	<10

SF-0-5 DATA

ANALYZED 8/25/93

SAMPLE	METHANE	CARBON DIOXIDE	OXYGEN
82A	0.001	373	1.358
82B	0.001	409	1.911
82C	0.002	624	1.514
82D	ND	747	2.266
82E	ND	295	6.396
82F	0.019	453	2.110
82H	ND	424	7.072
82-MW-10	0.004	640	2.539
82-MW-11 REP1	0.117	726	1.585
82-MW-11 REP2	0.095	822	2.107

LOWER LIMITS OF QUANTITATION:

	METHANE	CARBON DIOXIDE	OXYGEN
	0.001	0.169	0.275

UNITS ARE mg/L.

MANTECH

Ref: 93-LP27/vg

November 16, 1993

Dr. Don Kampbell
R.S. Kerr Environmental Research Lab
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

THRU: S.A. Vandegrift SAV

Dear Don:

TOC results follow for nine samples submitted under Service Request #SF-0-27. The samples were received November 10 and stored at 6°C until November 15 when analyses were done using RSKSOP-102. Blanks, duplicates, and known AQC samples were analyzed along with your samples for quality control.

Sample	mg/L TOC
82 A	2.2
82 B	3.1
82 C	6.0
82 D	5.2
82 D Dup	5.3
82 E	1.9
82 F	1.9
82 H	1.6
MW-10	5.3
MW-11	4.0
MW-11 Dup	3.8
WP030	13.6
WP030 T.V.	14.0

Sincerely,

Lynda Pennington

Lynda Pennington

xc: R.L. Cosby
J.L. Seeley
J. Wilson

ManTech Environmental Technology, Inc.
P.O. Box 12313, 2 Triangle Drive, Research Triangle Park, North Carolina 27709 919-549-0611 FAX 919-549-4665

MANTECH ENVIRONMENTAL TECHNOLOGY

Ref: 93-PR48/vg

November 16, 1993

Dr. Don Kampbell/Dr. John Wilson
R.S. Kerr Environmental Research Lab
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

THRU: S.A. Vandegrift SAV

Dear Don/John:

Attached are the results of 9 Hill AFB samples submitted to ManTech Environmental as part of Service Request #SF-0-27. The samples were received on November 10, 1993, and analyzed November 11, 12, and 15. The methods used for analysis were EPA methods 353.1 and 365.1 along with Water's capillary electrophoresis method N-601. Blanks, spikes, duplicates, and known AQC samples were analyzed along with the samples for quality assurance.

If you have any questions concerning these results, please feel free to contact me.

Sincerely,

Priscilla Rhynes

Priscilla Rhynes

xc: R.L. Cosby
J.L. Seeley JLS

ManTech Environmental Technology, Inc.
P.O. Box 12313, 2 Triangle Drive, Research Triangle Park, North Carolina 27709 919-549-0611 FAX 919-549-4665

Sample	mg/l $NO_2^- + NO_3^-(N)$	mg/l Cl^-	mg/l $SO_4^=$	mg/l T-P
82 A	.08	159	60.5	.06
82 B	.37	144	72.2	.06
82 C	.08	109	17.2	.95
82 D	.13	151	116	.12
82 E	5.61	76.4	65.8	.10
82 F	5.07	60.2	55.5	.06
82 F Dup	5.06	60.7	55.0	.06
82 H	2.01	104	55.7	.08
MW 10	17.4	33.9	53.1	.86
MW 10 Dup	17.1			
MW 11	.17	29.5	94.1	3.95
MW 11 Dup				3.96
AQCWP030	7.24	176	38.5	1.56
True Value	7.10	178	42.0	1.60
Spike Recovery	104%	97%	98%	106%

SF-0-27 DATA

ANALYZED 11/10/93

SAMPLE	METHANE	CARBON DIOXIDE
82A	0.001	530
82B	ND	462
82C	0.002	733
82D	ND	1122
82E	ND	452
82F	0.006	552
82H	ND	513
MW-10	0.001	590
MW-11	0.022	914

LOWER LIMITS OF QUANTITATION

	0.001	0.17

UPPER LIMITS OF QUANTITATION

	0.940	1519

UNITS ARE mg/L.

MANAGEMENT TECHNOLOGY

Ref: 93-BN27/vg

December 2, 1993

Dr. John Wilson
R.S. Kerr Environmental Research Lab
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

THRU: S.A. Vandegrift SAV

Dear John:

Below find results for methane on the Hill AFB sa[illegible]e as per Service Request #SF-0-35. The sample was received on N[illegible]mber 19, 1993 and analyzed on November 23, 1993. The sample was p[illegible]pared as described in the paper "Dissolved Oxygen and Methane in Water by a GC Headspace Equilibration Technique", by Kampbell et.al., in International Journal of Environmental Analytical Chemistry, volume 36, pp. 249-257. Analysis and calculation of methane was performed as per RSKSOP-147.

Sample	Methane Concentration
EPA 82-I	0.68 mg/L

If you have any questions, please feel free to see me.

Sincerely,

Bryan Newell

Bryan Newell

xc: R.L. Cosby
J.L. Seeley jlo

ManTech Environmental Technology, Inc.
P.O. Box 12313, 2 Triangle Drive, Research Triangle Park, North Carolina 27709 919-549-0611 FAX 919-549-4665

ROBERT S. KERR ENVIRONMENTAL RESEARCH LABORATORY
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
SUBSURFACE PROCESSES BRANCH
P.O. BOX 1198
ADA, OKLAHOMA 74820

FAX NUMBER: 405/436-8703

FACSIMILE TRANSMITTAL SHEET

DATE: 2-28-94
NUMBER OF PAGES (Including cover sheet): 2

TO: Leigh Benson
PHONE: 303/831-8100
FAX: 303-831-8208

No Soil Data
82-E
82-F
82-H

FROM: John Wilson
PHONE: 405-436-8532

COMMENTS/MESSAGE: These numbers are for modeling sorption of BTEX compounds to aquifer solids at Hill AFB. Assume that Total Soil % organic carbon is appropriate number for modeling.

CC: Todd Wiedemeyer - please.

MANTECH ENVIRONMENTAL TECHNOLOGY

Ref: 94-LP9/rc

February 22, 1994

Dr. John Wilson
R.S. Kerr Environmental Research Lab
U.S. Environmental Protection Agency
Post Office Box 1198
Ada, OK 74820

THRU: S.A. Vandegrift SAV

Dear John:

Attached are TOC results for a set of four soils submitted to ManTech Environmental February 14, 1994 under Service Request # SF-0-46. The method used for these determinations was RSKSOP-120. The soil sample labeled "82E-15" was subsampled in a glove box to maintain anaerobic conditions in the jar.

A Leco standard soil was analyzed along with your samples for quality control.

If you have any questions concerning this data, please feel free to ask me.

Sincerely,

Lynda Pennington

Lynda Pennington

xc: R.L. Cosby
J.L. Seeley

ManTech Environmental Technology, Inc.
P.O. Box 12313, 2 Triangle Drive, Research Triangle Park, North Carolina 27709 919-549-0611 FAX 919-549-4665

Sample	Soil Filtrate % O.C.	Solids % O.C	Total Soil % O.C.	Mean ± 1 sd Soil % TOC
82E-12-1	.007	.046	.053	
82E-12-2	.009	.056	.065	.069 ± .019
82E-12-3	.007	.083	.090	
82E-14-1	.007	.074	.081	
82E-14-2	.006	.062	.068	.070 ± .011
82E-14-3	.006	.054	.060	
82E-15-1	.014	.071	.085	
82E-15-2	.018	.074	.092	.087 ± .004
82E-15-3	.012	.073	.085	
82E-17-1	.011	.101	.112	
82E-17-2	.011	.078	.089	.094 ± .017
82E-17-3	.012	.068	.080	
LECO STD SOIL		1.022		
		1.034		
LECO STD SOIL T.V.		1.00 ± .04		

Sample	Soil Filtrate % O.C.	Solids % O.C	Total Soil % O.C.	Mean ± 1 sd Soil % TOC
82E-12-1	.007	.046	.053	
82E-12-2	.009	.056	.065	.069 ± .019
82E-12-3	.007	.083	.090	
82E-14-1	.007	.074	.081	
82E-14-2	.006	.062	.068	.070 ± .011
82E-14-3	.006	.054	.060	
82E-15-1	.014	.071	.085	
82E-15-2	.018	.074	.092	.087 ± .004
82E-15-3	.012	.073	.085	
82E-17-1	.011	.101	.112	
82E-17-2	.011	.078	.089	.094 ± .017
82E-17-3	.012	.068	.080	
LECO STD SOIL		1.022		
		1.034		
LECO STD SOIL T.V.		1.00 ± .04		

Duplicates

ROBERT S. KERR ENVIRONMENTAL RESEARCH LABORATORY
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
SUBSURFACE PROCESSES BRANCH
P.O. BOX 1198
ADA, OKLAHOMA 74820

FAX NUMBER: 405/436-8703

FACSIMILE TRANSMITTAL SHEET

DATE: 4-4-94
NUMBER OF PAGES (Including cover sheet): 38

TO: Todd Wiedemeier
PHONE: 303-831-8100
FAX: 303-831-8208

FROM: John Wilson
PHONE: 405-436-8532

COMMENTS/MESSAGE:

MANAGEMENT TECHNOLOGY

Ref: 93-BB18

November 24, 1993

Dr. John Wilson
R.S. Kerr Environmental Research Lab
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

THRU: S.A. Vandegrift SAV

Dear John:

As requested in Service Request # SF-0-35, headspace GC/MS analysis of 2 water samples for BTEXXXTMB compounds was completed. The samples were received on November 19,1993 and analyzed on November 23, 1993. RSKSOP-158 (Determination of Volatile Aromatic Compounds and Tert-Butylmethylether in Water by Automated Headspace Gas Chromatography/Mass Spectrometry (Saturn II Ion Trap Detector) was used for this analysis.

An internal standard calibration method was established for the 9 aromatic compounds. The standard curves were prepared using concentrations of 1.0 to 4000 ppb. The lower quantitation limits were 0.5 ppb.

The samples were analyzed undiluted and were prepared by adding 10 ml of sample to a headspace vial containing 2 g of sodium chloride (NaCl). 8 μl of 125 μg/ml fluorobenzene was added to this 10 ml liquid volume before the vial was capped.

A quantitation report for the samples and a QC standard is presented in Table 1.

If you should have any questions, please feel free to contact me.

Sincerely,

Bradley D. Black

Bradley D. Black

xc: R.L. Cosby
G.B. Smith
D.D. Fine
J.L. Seeley jls

ManTech Environmental Technology, Inc

P.O. Box 12313, 2 Triangle Drive, Research Triangle Park, North Carolina 27709 919-549-0611 FAX 919-549-4665

Table 1. Quantitation Report for SR# SF-0-35.

Concentration = ppb

Compound	EPA 82-I	TRIP BLANK	QC1123C 500 ppb
Benzene	2740	---	503
Toluene	372	---	508
Ethylbenzene	486	---	510
p-Xylene	784	---	510
m-Xylene	1370	---	508
o-Xylene	1140	---	510
1,3,5-Trimethylbenzene	162	---	500
1,2,4-Trimethylbenzene	495	---	507
1,2,3-Trimethylbenzene	240	---	513

QC = Quality Control Standard --- = Below Quantitation Limit (0.5 ppb)

Hill AFB Monitoring Well Samples

Location	Date	pH	D.O. mg/l	Temp. C°	Depth To Water feet	Fe^{+2} mg/l
82 A	11/8/93	7.4	0.3	14.8	4.46	0.17
82 B	11/8/93	7.5	1.2	12.9	25.37	0.11
82 C	11/9/93	6.3	0.4	14.2	22.17	0.84
82 D	11/9/93	7.2	0.8	14.1	23.72	1.7
82 E	11/8/93	7.4	2.7	16.5	6.26	0.02
82 F	11/8/93	7.6	1.1	16.8	7.30	0.04
82 H	11/8/93	7.4	5.4	15.7	11.46	0.19
MW-10	11/9/93	7.4	1.5	15.0	28.05	0.22
MW-11	11/9/93	7.4	0.1	14.7	25.74	0.05

Don Kampbell

MANAGEMENT TECHNOLOGY

Ref: 93-BN27/vg

December 2, 1993

Dr. John Wilson
R.S. Kerr Environmental Research Lab
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

THRU: S.A. Vandegrift SAV

Dear John:

Below find results for methane on the Hill AFB sample as per Service Request #SF-0-35. The sample was received on November 19, 1993 and analyzed on November 23, 1993. The sample was prepared as described in the paper "Dissolved Oxygen and Methane in Water by a GC Headspace Equilibration Technique", by Kampbell et.al., in International Journal of Environmental Analytical Chemistry, volume 36, pp. 249-257. Analysis and calculation of methane was performed as per RSKSOP-147.

Sample	Methane Concentration
EPA 82-I	0.68 mg/L

If you have any questions, please feel free to see me.

Sincerely,

Bryan Newell

Bryan Newell

xc: R.L. Cosby
J.L. Seeley jls

ManTech Environmental Technology, Inc.
P.O. Box 12313, 2 Triangle Drive, Research Triangle Park, North Carolina 27709 919-549-0611 FAX 919-549-4665

MANAGEMENT TECHNOLOGY

Ref: 93-BN23/vg

November 15, 1993

Dr. Don Kampbell
R.S. Kerr Environmental Research Lab
U.S. Environmental Protection Agency
Post Office Box 1198
Ada, OK 74820

THRU: S.A. Vandegrift SAV

Dear Don:

Find attached results for methane and carbon dioxide on Hill AFB samples as per Service Request #SF-0-27. Samples were received and analyzed on November 10, 1993. Samples were prepared as described in the paper "Dissolved Oxygen and Methane in Water by a GC Headspace Equilibration Technique", by Kampbell et al., in International Journal of Environmental Analytical Chemistry, Volume 36, pp. 249-257. Analysis and calculations of carbon dioxide was performed as per RSKSOP-114, and analysis and calculations of methane was performed as per RSKSOP-147.

If you have any questions, please feel free to see me.

Sincerely,

Bryan Newell

Bryan Newell

xc: R.L. Cosby
J.L. Seeley jls
J.T. Wilson
M.C. Cook

SF-0-27 DATA

ANALYZED 11/10/93

SAMPLE	METHANE	CARBON DIOXIDE
82A	0.001	530
82B	ND	462
82C	0.002	733
82D	ND	1122
82E	ND	452
82F	0.006	552
82H	ND	513
MW-10	0.001	590
MW-11	0.022	914

LOWER LIMITS OF QUANTITATION

	0.001	0.17

UPPER LIMITS OF QUANTITATION

	0.940	1519

UNITS ARE mg/L.

MANTECH ENVIRONMENTAL TECHNOLOGY

Ref: 93-PR48/vg

November 16, 1993

Dr. Don Kampbell/Dr. John Wilson
R.S. Kerr Environmental Research Lab
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

THRU: S.A. Vandegrift SAV

Dear Don/John:

Attached are the results of 9 Hill AFB samples submitted to ManTech Environmental as part of Service Request #SF-0-27. The samples were received on November 10, 1993, and analyzed November 11, 12, and 15. The methods used for analysis were EPA methods 353.1 and 365.1 along with Water's capillary electrophoresis method N-601. Blanks, spikes, duplicates, and known AQC samples were analyzed along with the samples for quality assurance.

If you have any questions concerning these results, please feel free to contact me.

Sincerely,

Priscilla Rhynes

Priscilla Rhynes

xc: R.L. Cosby
J.L. Seeley

ManTech Environmental Technology, Inc.
P.O. Box 12313, 2 Triangle Drive, Research Triangle Park, North Carolina 27709 919-549-0611 FAX 919-549-4665

Sample	mg/l $NO^-_2 + NO^-_3(N)$	mg/l Cl^-	mg/l $SO^=_4$	mg/l T-P
82 A	.08	159	60.5	.06
82 B	.37	144	72.2	.06
82 C	.08	109	17.2	.95
82 D	.13	151	116	.12
82 E	5.61	76.4	65.8	.10
82 F	5.07	60.2	55.5	.06
82 F Dup	5.06	60.7	55.0	.06
82 H	2.01	104	55.7	.08
MW 10	17.4	33.9	53.1	.86
MW 10 Dup	17.1			
MW 11	.17	29.5	94.1	3.95
MW 11 Dup				3.96
AQCWP030	7.24	176	38.5	1.56
True Value	7.10	178	42.0	1.60
Spike Recovery	104%	97%	98%	106%

(4)

MANAGEMENT TECHNOLOGY

Ref: 93-LP27/vg

November 16, 1993

Dr. Don Kampbell
R.S. Kerr Environmental Research Lab
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

THRU: S.A. Vandegrift SAV

Dear Don:

TOC results follow for nine samples submitted under Service Request #SF-0-27. The samples were received November 10 and stored at 6°C until November 15 when analyses were done using RSKSOP-102. Blanks, duplicates, and known AQC samples were analyzed along with your samples for quality control.

Sample	mg/L TOC
82 A	2.2
82 B	3.1
82 C	6.0
82 D	5.2
82 D Dup	5.3
82 E	1.9
82 F	1.9
82 H	1.6
MW-10	5.3
MW-11	4.0
MW-11 Dup	3.8
WP030	13.6
WP030 T.V.	14.0

Sincerely,

Lynda Pennington

Lynda Pennington

xc: R.L. Cosby
J.L. Seeley jb
J. Wilson

MANAGEMENT TECHNOLOGY

Ref: 93-LS24

November 17, 1993

Dr. Don Kampbell
R.S. Kerr Environmental Research Lab
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74821-1198

THRU: S.A. Vandegrift SAV

Dear Don:

Please find attached results for the Hill AFB analyses of aqueous samples to be analyzed by purge-and-trap/GC:FID-PID for Benzene, Toluene, Ethylbenzene, p-, m-, & o-Xylene, 1,3,5-, 1,2,4-, & 1,2,3-Trimethylbenzene and Total Fuel Carbon. We received a total of 9 samples, in duplicate, on November 10, 1993. The samples received were in capped, 40 mL VOA autosampler vials preserved with lead-lined septa and 0.4 g Na_3PO_4. All samples were stored at 4°C until analyzed. Samples were analyzed on November 16, 1993. All samples were acquired and processed using the MAXIMA data system. A 5 place external standard curve (1-10-100-500-1000 ppb) was used to quantitate the samples.

This work was performed under Service Request #SF-0-27. RSKSOP-133, "Simultaneous Analysis of Aromatics and Total Fuel Carbon by Dual Column-Dual Detector for Ground Water Samples" was used for these analyses.

Sincerely,

Lisa R Secrest

Lisa R. Secrest

xc: R.L. Cosby
J. Wilson
J.L. Seeley JLS

Printed 17-. , SR: SF-0-27 OI-P&T/GC:FID-PID . s for Dr. Kampbell Units = ng/ml A. . Secreel

SAMPLE NAME	BENZENE	TOLUENE	ETHYLBENZENE	p-XYLENE	m-XYLENE	o-XYLENE	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB	FUEL CARBON
100 PPB	1.01E+02	1.01E+02	1.01E+02	1.01E+02	1.01E+02	1.00E+02	1.01E+02	1.01E+02	1.00E+02	N/A
QC, OBSERVED, PPB	4.83E+01	4.93E+01	4.95E+01	5.01E+01	4.94E+01	4.99E+01	4.77E+01	5.14E+01	4.80E+01	N/A
QC, TRUE VALUE, PPB	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	N/A
62-A	ND	BLQ	ND	ND	ND	ND	1.14E+00	9.65E-01	BLQ	BLQ
62-B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
62-B Duplicate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
62-C	ND	5.38E+00	6.61E+00	2.02E+01	6.38E+00	1.82E+00	7.97E+01	6.89E+01	6.41E+01	1.13E+03
62-D	1.74E+02	4.84E+00	3.06E+01	1.41E+02	2.93E+02	5.75E+01	8.94E+01	1.19E+02	7.71E+01	1.50E+03
62-E	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
62-F	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
62-H	ND	ND	ND	ND	ND	ND	9.42E-01	BLQ	BLQ	BLQ
MW-10	7.44E+00	6.29E+01	1.90E+02	1.88E+02	1.09E+03	5.05E+02	1.74E+02	2.97E+02	2.12E+02	4.52E+03
MW-11	1.05E+02	4.65E+01	3.99E+01	6.50E+01	2.21E+02	8.64E+01	3.00E+01	5.57E+01	2.87E+01	9.25E+02
GC LAB BLANK, PPB	ND	ND	ND	ND	ND	ND	ND	ND	ND	N/A
500 PPB	4.71E+02	4.70E+02	4.67E+02	4.67E+02	4.68E+02	4.74E+02	4.73E+02	4.76E+02	4.81E+02	N/A
QC, OBSERVED, PPB	4.89E+01	4.96E+01	4.98E+01	5.00E+01	4.90E+01	5.02E+01	4.65E+01	5.08E+01	4.90E+01	N/A
QC, TRUE VALUE, PPB	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	N/A
10 PPB	1.00E+01	1.00E+01	1.02E+01	9.80E+00	9.81E+00	9.96E+00	9.55E+00	9.71E+00	9.86E+00	N/A

ND = None Detected; N/A = Not Analyzed; BLQ = Below Limit of Quantitation, 1 ppb

Ref: 93-DK11/vg

November 8, 1993

Dr. John Wilson
R.S. Kerr Environmental Research Lab
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

THRU: S.A. Vandegrift SAV

Dear John:

I have determined average molecular weight for your sample extracts MW10A and MW10B from Hill AFB. The "Number-Average Molecular Weight" method was calculated. Please see the attached reference material for details. My results are as follows:

MW10A = 156

MW10B = 160

This work was performed under Service Request #SF-0-32.

In summary, methylene chloride extracts of the soil cores were analyzed by GC/MSD on October 31 and November 1, 1993. The samples were taken from crimp capped autosampler vials previously analyzed by GC/MS, August 13-17, 1993, by D. Fine under Service Request #SF-0-1 (Ref: 93-DF5). My TIC chromatograms of the two samples are attached. Calibration curves created from the analysis of 117 different petroleum compounds including n-paraffins, isoparaffins, aromatics, olefins, naphthenes, (referred to by the acronym PIANO) and PNAs were used to determine the concentration of every detected peak in the extract in terms of µg/ml and µM/ml. This was done by relating retention time to "response factor". Graphs of these calibration curves are attached. The number-average molecular weight is the sum of the weights of each molecular species divided by the sum over all molecular species of the number of moles of each species.

If you require further information, please feel free to contact me.

Sincerely,

David A. Kovacs

David A. Kovacs

xc: R.L. Cosby
G. Smith
J.L. Seeley

ManTech Environmental Technology, Inc.

P.O. Box 12313, 2 Triangle Drive, Research Triangle Park, North Carolina 27709 919-549-0611 FAX 919-549-4665

MANAGEMENT TECHNOLOGY

Ref: 93-DK4/vg

September 1, 1993

Dr. Don Kampbell
R.S. Kerr Environmental Research Lab
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

THRU: S.A. Vandegrift SAV

Dear Don:

Please find attached results of GC/MSD analysis of Hill AFB core extracts for quantitation of Benzene, Toluene, Ethylbenzene (EB), p-Xylene, m-Xylene, o-Xylene, 1,3,5-Trimethylbenzene (1,3,5-TMB), 1,2,4-Trimethylbenzene (1,2,4-TMB) and 1,2,3-Trimethylbenzene (1,2,3-TMB) as requested under Service Request #SF-0-5.

The analytical method was a modification of RSKSOP-124. Cool (38°C) on-column injection (0.5 µl) was used with electronic pressure control (EPC) set for a constant flow of 0.9 ml/min. A 30M X 0.25 mm Restek Stabilwax (Crossbonded Carbowax-PEG, 0.5 µm film) capillary GC column with 1 foot long X 0.53 mm ID uncoated capillary precolumn was used. Quantification was based on two standard curves: A low level curve was used for extract concentrations in the range 0.01-1.0 µg/ml (0.01,0.1,1.0 µg/ml). The second curve was used for quantification of concentrations >1.0 (1,10,100,333 µg/ml).

If you require further information, please feel free to contact me.

Sincerely,

David A. Kovacs

David A. Kovacs

xc: R.L. Cosby
G. Smith
J.L. Seeley jls

ManTech Environmental Technology, Inc.
P.O. Box 1198, Ada, Oklahoma 74820 405-332-8800 FAX 405-332-8800 ext. 235

SR#SF-ᴗ-ᴗ ᴗr. Kampbell — Hill AFB Core Extracts ●..MSD Analyses — Units = mg/..

SAMPLE NAME	BENZENE	TOLUENE	EB	p-XYLENE	m-XYLENE	o-XYLENE	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB
1 µg/ml	9.06E-01	1.00E+00	1.07E+00	1.05E+00	1.06E+00	1.09E+00	1.10E+00	1.09E+00	1.07E+00
82A-1	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-2	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-3	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-4	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-5	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-6	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-7	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-8	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-9	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-10	ND	ND	ND	ND	ND	ND	ND	ND	ND
10 µg/ml	1.06E+01	1.04E+01	1.04E+01	1.03E+01	1.05E+01	1.05E+01	1.05E+01	1.05E+01	1.05E+01
1 µg/ml	1.07E+00	1.02E+00	1.02E+00	1.02E+00	1.02E+00	1.02E+00	1.02E+00	1.02E+00	1.02E+00
82A-11	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-12	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-13	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-14	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-15	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-16	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-17	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-18	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-19	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-20	ND	ND	ND	ND	ND	ND	ND	ND	ND
100 µg/ml	1.05E+02	1.06E+02	1.07E+02	1.08E+02	1.06E+02	1.06E+02	1.06E+02	1.07E+02	1.07E+02
100 µg/ml QC	9.72E+01	9.35E+01	9.28E+01	9.29E+01	9.19E+01	9.19E+01	9.18E+01	9.23E+01	9.20E+01
82A-21	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-22	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-23	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-24	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-25	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-26	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-27	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-28	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-29	ND	ND	ND	ND	ND	ND	ND	ND	ND

Analyst: David A. Kovacs — BLQ < 0.01 µg/ml

SR#SF-0-6 [illegible]. Kampbell — Hill AFB Core Extracts G[illegible]MSD Analyses — Units=mg/[illegible]

SAMPLE NAME	BENZENE	TOLUENE	EB	p-XYLENE	m-XYLENE	o-XYLENE	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB
82A-30	ND	ND	ND	ND	ND	ND	ND	ND	ND
MeCl2	BLQ	BLQ	BLQ	ND	BLQ	BLQ	BLQ	BLQ	ND
0.1 µg/ml	1.08E-01	9.95E-02	1.01E-01	9.94E-02	9.81E-02	1.02E-01	1.01E-01	1.01E-01	1.03E-01
0.01 µg/ml	1.11E-02	9.74E-03	1.04E-02	1.02E-02	1.01E-02	1.09E-02	1.28E-02	1.06E-02	1.22E-02
1 µg/ml	9.62E-01	9.30E-01	9.20E-01	9.10E-01	9.13E-01	9.35E-01	9.33E-01	9.17E-01	9.23E-01
82A-31	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-32	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-33	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-34	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-35	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-36	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-37	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-38	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-39	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-40	ND	ND	ND	ND	ND	ND	ND	ND	ND
100 µg/ml	1.04E+02	1.06E+02	1.06E+02	1.06E+02	1.06E+02	1.06E+02	1.06E+02	1.06E+02	1.06E+02
10 µg/ml QC	9.56E+00	9.35E+00	9.51E+00	9.19E+00	9.39E+00	9.42E+00	9.36E+00	9.41E+00	9.44E+00
82A-41	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-42	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-43	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-44	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-45	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-46	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-47	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-48	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-49	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-50	ND	ND	ND	ND	ND	ND	ND	ND	ND
1 µg/ml	1.04E+00	1.04E+00	1.05E+00	1.06E+00	1.06E+00	1.04E+00	1.05E+00	1.04E+00	1.04E+00
0.1 µg/ml	1.18E-01	1.11E-01	1.10E-01	1.11E-01	1.11E-01	1.10E-01	1.12E-01	1.12E-01	1.13E-01
82A-51	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-52	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-53	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-54	ND	ND	ND	ND	ND	ND	ND	ND	ND
82A-55	ND	ND	ND	ND	ND	ND	ND	ND	ND

Analyst: David A. Kovacs — BLQ < 0.01 µg/ml — Printed: 9/1/93

SR#SF-0-5 Dr. Kampbell — Hill AFB Core Extracts GC/MSD Analyses — Units=mg/kg

SAMPLENAME	BENZENE	TOLUENE	EB	p-XYLENE	m-XYLENE	o-XYLENE	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB
82B-1	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-2	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-3	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-4	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-5	ND	ND	ND	ND	ND	ND	ND	ND	ND
0.01 µg/ml	1.31E-02	1.10E-02	1.13E-02	1.14E-02	1.13E-02	1.08E-02	1.35E-02	1.11E-02	1.26E-02
0.1 µg/ml	8.94E-02	9.36E-02	9.41E-02	9.38E-02	9.38E-02	9.45E-02	9.29E-02	9.34E-02	9.22E-02
1 µg/ml	9.58E-01	9.60E-01	9.47E-01	9.38E-01	9.38E-01	9.59E-01	9.46E-01	9.56E-01	9.83E-01
10 µg/ml QC	9.25E+00	9.52E+00	1.00E+01	9.36E+00	9.51E+00	9.76E+00	9.30E+00	9.34E+00	9.52E+00
1 µg/ml	9.17E-01	9.92E-01	1.02E+00	1.02E+00	1.02E+00	1.03E+00	1.03E+00	1.04E+00	1.04E+00
82B-6	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-7	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-8	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-9	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-10	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-11	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-12	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-13	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-14	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-15	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-16	ND	ND	ND	ND	ND	ND	ND	ND	ND
MeCl2	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	ND
0.1 µg/ml	1.02E-01	1.03E-01	1.04E-01	1.05E-01	1.05E-01	1.05E-01	1.04E-01	1.05E-01	1.04E-01
1 µg/ml	9.37E-01	9.78E-01	9.64E-01	9.70E-01	9.69E-01	9.62E-01	9.43E-01	9.64E-01	9.56E-01
82B-17	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-18	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-19	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-20	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-21	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-22	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-23	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-24	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-25	ND	ND	ND	ND	ND	ND	ND	ND	ND
82C-14	ND	ND	ND	ND	ND	ND	ND	ND	ND

Analyst: David A. Kovacs — BLQ < 0.01 µg/ml

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SR#SF-ι- ʳ.Kampbell   Hill AFB Core Extracts ● ASD Analyses   Units=mg.

SAMPLE NAME	BENZENE	TOLUENE	EB	p-XYLENE	m-XYLENE	o-XYLENE	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB
82C-16	ND	ND	ND	ND	ND	ND	1.39E-02	1.67E-02	4.91E-03
10 µg/ml QC	9.52E+00	9.62E+00	1.00E+01	9.34E+00	9.53E+00	9.77E+00	9.41E+00	9.64E+00	9.76E+00
100 µg/ml	9.87E+01	1.03E+02	1.03E+02	1.05E+02	1.03E+02	1.03E+02	1.04E+02	1.04E+02	1.04E+02
82C-19	6.21E-03	BLQ	1.80E-02	4.20E-02	2.57E-02	1.51E-02	1.65E+00	1.16E+00	1.08E-01
82C-20	BLQ	1.76E-02	6.18E-03	2.96E-02	9.10E-03	4.01E-03	1.60E+00	1.03E+00	5.63E-02
82C-21	3.67E-03	1.92E-02	5.58E-03	3.65E-02	9.56E-03	BLQ	2.34E+00	2.04E+00	2.08E-01
82C-22	3.27E-03	2.00E-02	2.86E-02	8.57E-02	6.62E-02	BLQ	3.70E+00	4.42E+00	9.05E-01
82C-23	BLQ	BLQ	6.42E-03	1.10E-02	9.91E-03	BLQ	8.01E-02	7.41E-02	8.13E-03
82C-24	BLQ	BLQ	7.95E-03	1.05E-02	1.89E-02	BLQ	1.48E-02	1.68E-02	3.63E-03
82C-25	BLQ	BLQ	1.24E-02	2.21E-02	5.21E-02	1.36E-02	3.88E-02	5.40E-02	2.29E-02
82C-26	BLQ	BLQ	1.18E-02	1.78E-02	4.18E-02	7.18E-03	2.90E-02	3.71E-02	1.45E-02
82D-1	9.59E-03	BLQ	1.59E-02	BLQ	BLQ	BLQ	4.16E-03	BLQ	BLQ
82D-3	ND	BLQ	3.35E-03	BLQ	3.36E-03	BLQ	1.74E-02	8.85E-03	3.11E-03
82D-4	BLQ	BLQ	8.71E-03	1.36E-02	3.45E-02	4.51E-03	1.95E-01	2.25E-01	5.48E-02
MeCl2	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
Method Blank	ND	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
0.01 µg/ml	1.02E-02	9.59E-03	1.00E-02	1.02E-02	1.02E-02	9.83E-03	1.11E-02	1.02E-02	1.15E-02
0.1 µg/ml	9.87E-02	9.93E-02	9.87E-02	9.88E-02	9.86E-02	9.86E-02	9.85E-02	9.66E-02	9.62E-02
1 µg/ml	1.09E+00	1.01E+00	1.00E+00	1.00E+00	9.98E-01	9.95E-01	9.88E-01	9.91E-01	9.83E-01
82D-5	BLQ	BLQ	ND	BLQ	BLQ	BLQ	BLQ	4.98E-03	BLQ
82D-6	BLQ	BLQ	ND	ND	ND	ND	ND	ND	ND
82D-12	2.03E-02	BLQ	1.15E-01	4.54E-03	1.67E-02	BLQ	6.32E-03	4.16E-03	BLQ
82D-13	1.85E-02	BLQ	1.41E-01	7.56E-03	2.75E-02	4.76E-03	8.71E-03	5.72E-03	BLQ
82D-14	2.09E-02	BLQ	1.24E-01	6.62E-02	1.94E-02	BLQ	6.37E-02	6.95E-02	6.18E-03
82D-15	3.43E-02	BLQ	8.78E-02	3.90E-02	1.21E-01	3.23E-02	4.33E-02	3.03E-02	1.27E-02
82D-16	3.16E-02	3.04E-03	6.13E-02	5.51E-02	1.81E-01	4.50E-02	3.65E-02	3.99E-02	2.13E-02
82D-17	6.30E-03	BLQ	2.13E-02	BLQ	BLQ	BLQ	1.47E-02	BLQ	ND
82D-18	7.92E-03	BLQ	3.44E-02	BLQ	BLQ	BLQ	2.58E-02	BLQ	ND
100 µg/ml	1.13E+02	1.08E+02	1.08E+02	1.08E+02	1.08E+02	1.08E+02	1.09E+02	1.09E+02	1.09E+02
10 µg/ml	1.10E+01	9.98E+00	9.96E+00	9.98E+00	1.00E+01	1.00E+01	1.00E+01	9.86E+00	9.95E+00
82D-19	8.29E-03	BLQ	6.04E-02	3.88E-02	5.29E-03	5.77E-03	8.82E-02	7.80E-02	8.21E-03
82D-21	1.04E-02	BLQ	9.49E-02	BLQ	3.03E-03	BLQ	4.77E-03	3.10E-03	ND
82D-22	6.97E-02	BLQ	1.11E-01	1.30E-02	BLQ	BLQ	3.04E-02	1.11E-02	BLQ
82D-23	2.71E-01	BLQ	1.48E+00	1.62E+00	3.40E+00	7.32E-01	2.63E+00	3.11E+00	8.17E-01

Analyst: David A. Kovacs   BLQ < 0.01 µg/ml

SR#SF-0~ Dr. Kampbell   Hill AFB Core Extracts ● "ISD Analyses   Units = mg

SAMPLENAME	BENZENE	TOLUENE	EB	p-XYLENE	m-XYLENE	o-XYLENE	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB
82D-24	1.29E-01	BLQ	2.64E-01	2.76E-01	6.55E-01	1.44E-01	3.73E-01	4.40E-01	1.36E-01
82D-25	1.03E-02	BLQ	1.06E-02	5.75E-03	1.43E-02	3.59E-03	7.44E-03	7.02E-03	BLQ
82D-38	3.93E-02	8.09E-03	1.28E-01	1.06E-02	1.01E-01	6.92E-02	7.33E-02	1.07E-02	3.84E-02
82D-39	3.88E-02	BLQ	1.37E-01	BLQ	4.04E-03	4.86E-03	7.70E-03	BLQ	BLQ
82D-40	3.14E-02	BLQ	1.71E-01	3.78E-02	1.11E-01	2.42E-02	4.39E-02	3.73E-02	1.63E-02
82E-2	ND	ND	ND	ND	ND	ND	ND	ND	ND
1 µg/ml	1.05E+00	1.02E+00	9.94E-01	9.85E-01	9.93E-01	9.93E-01	1.02E+00	9.89E-01	1.00E+00
0.1 µg/ml	1.08E-01	1.03E-01	1.02E-01	1.01E-01	1.01E-01	9.99E-02	1.00E-01	9.91E-02	9.93E-02
82E-3	ND	ND	ND	ND	ND	ND	ND	ND	ND
82E-13	ND	ND	ND	ND	ND	ND	ND	ND	ND
82E-14	ND	ND	ND	ND	ND	ND	ND	ND	ND
82E-16	ND	ND	ND	ND	ND	ND	ND	ND	ND
82E-17	ND	ND	ND	ND	ND	ND	ND	ND	ND
82I-6	1.61E+00	2.04E-01	1.12E+01	2.34E+01	6.31E+01	1.99E+01	2.93E+01	6.09E+01	1.93E+01
MeCl2	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
333 µg/ml	3.49E+02	3.46E+02	3.44E+02	3.56E+02	3.45E+02	3.44E+02	3.43E+02	3.43E+02	3.42E+02
82I-15	6.01E-01	1.07E+00	3.72E+00	4.81E+00	1.05E+01	5.58E+00	2.94E+00	8.45E+00	2.03E+00
82I-16	3.33E-01	3.04E-01	1.12E+00	1.48E+00	1.83E+00	1.72E+00	8.57E-01	2.33E+00	6.72E-01
82I-17	6.53E-01	5.91E-01	3.39E+00	4.69E+00	4.89E+00	5.28E+00	3.04E+00	8.37E+00	2.34E+00
82I-18	6.29E-01	1.17E-01	1.31E+00	2.02E+00	9.88E-01	2.31E+00	1.62E+00	4.72E+00	1.26E+00
10 µg/ml QC	1.03E+01	9.16E+00	9.45E+00	8.67E+00	9.02E+00	9.17E+00	8.89E+00	9.01E+00	9.23E+00
100 µg/ml	1.00E+02	9.47E+01	9.40E+01	9.08E+01	9.39E+01	9.40E+01	9.51E+01	9.60E+01	9.60E+01
10 µg/ml	9.74E+00	9.81E+00	9.76E+00	1.02E+01	9.99E+00	1.00E+01	1.03E+01	1.02E+01	1.01E+01
1 µg/ml	9.89E-01	1.02E+00	1.02E+00	1.00E+00	1.01E+00	1.01E+00	1.08E+00	1.02E+00	1.01E+00
82I-19	6.78E-01	4.55E-02	1.60E-01	2.43E-01	5.17E-01	3.16E-01	8.43E-02	2.22E-01	7.78E-02
82I-20	5.38E-01	4.36E-02	1.52E-01	2.21E-01	6.04E-01	3.03E-01	7.47E-02	1.91E-01	7.09E-02
82I-21	6.65E-01	3.50E-02	1.59E-01	2.33E-01	6.12E-01	3.21E-01	7.96E-02	2.06E-01	7.83E-02
82I-22	7.71E-01	9.36E-02	1.60E-01	2.33E-01	6.21E-01	3.18E-01	9.36E-02	2.46E-01	8.99E-02
82I-23	1.45E+00	2.00E-01	2.83E-01	4.27E-01	1.16E+00	5.67E-01	1.57E-01	4.02E-01	1.55E-01
82I-24	7.87E-01	1.59E-01	1.50E-01	2.28E-01	6.16E-01	3.10E-01	7.43E-02	1.95E-01	7.49E-02
82I-25	8.68E-01	2.31E-01	1.87E-01	2.81E-01	8.02E-01	4.03E-01	1.03E-01	2.44E-01	9.09E-02
82I-26	7.49E-01	3.76E+00	1.03E+00	1.70E+00	4.74E+00	2.04E+00	1.24E+00	2.64E+00	9.58E-01
82I-27	4.90E-01	1.73E+00	3.77E-01	6.25E-01	1.84E+00	7.25E-01	3.84E-01	7.24E-01	2.72E-01
82I-28	BLQ	1.68E-02	BLQ	BLQ	8.84E-03	BLQ	BLQ	5.24E-03	BLQ

Analyst: David A. Kovacs   BLQ < 0.01 µg/ml   Printed: 9/1/93

SR#SF-0-5 Dr. Kampbell

Hill AFB Core Extracts GC/MSD Analyses

Units = mg/kg

SAMPLE NAME	BENZENE	TOLUENE	EB	p-XYLENE	m-XYLENE	o-XYLENE	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB
1 µg/ml	1.01E+00	1.05E+00	1.02E+00	1.01E+00	1.01E+00	1.03E+00	1.08E+00	1.04E+00	1.01E+00
0.1 µg/ml	1.05E-01	1.03E-01	9.81E-02	9.95E-02	9.92E-02	9.70E-02	9.36E-02	9.11E-02	9.63E-02
821-29	BLQ	1.57E-02	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
821-30	BLQ	1.11E-02	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
821-31	BLQ	1.14E-02	1.01E-01	ND	1.28E-02	BLQ	4.18E-01	1.91E-02	2.59E-01
821-32	1.36E-02	3.20E-02	1.24E+00	1.05E+00	1.79E+00	3.76E-02	1.31E+01	7.62E+00	3.09E+00
821-33	BLQ	1.22E-02	2.71E+01	ND	ND	ND	BLQ	BLQ	ND
821-34	BLQ	7.30E-03	1.61E+01	ND	ND	ND	ND	ND	ND
821-35	8.31E-03	1.37E-02	BLQ	BLQ	ND	BLQ	BLQ	BLQ	ND
821-36	6.12E-02	1.64E-02	2.38E-02	3.64E-02	8.98E-02	8.50E-02	1.21E-02	1.72E-02	9.37E-03
821-37	7.12E-01	1.82E-01	2.72E+00	3.96E+00	7.86E+00	4.79E+00	2.32E+00	6.38E+00	1.60E+00
821-38	3.15E-01	1.88E-02	1.21E-01	1.54E-01	5.92E-02	1.29E-01	3.10E-02	1.13E-01	3.10E-02
821-39	4.22E-01	6.74E-02	1.31E+00	1.75E+00	2.28E+00	1.03E+00	1.27E+00	3.30E+00	8.23E-01
MeCl2	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
Method Blank	ND	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
10 µg/ml QC	1.06E+01	1.06E+01	1.08E+01	1.04E+01	1.06E+01	1.06E+01	1.04E+01	1.05E+01	1.06E+01
100 µg/ml	1.07E+02	1.04E+02	1.04E+02	1.03E+02	1.04E+02	1.04E+02	1.04E+02	1.04E+02	1.04E+02

Analyst: David A. Kovacs

BLQ < 0.01 µg/ml

SR#S[illegible] Dr. Kampbell   Hill AFB Core Extra[illegible] [illegible]/MSD Analyses   Units = [illegible]

SAMPLE NAME	BENZENE	TOLUENE	EB	p-XYLENE	m-XYLENE	o-XYLENE	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB
82B-1	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-2	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-3	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-4	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-5	ND	ND	ND	ND	ND	ND	ND	ND	ND
0.01 µg/ml	1.31E-02	1.10E-02	1.13E-02	1.14E-02	1.13E-02	1.08E-02	1.35E-02	1.11E-02	1.25E-02
0.1 µg/ml	8.94E-02	9.36E-02	9.41E-02	9.38E-02	9.38E-02	9.45E-02	9.29E-02	9.34E-02	9.22E-02
1 µg/ml	9.58E-01	9.60E-01	9.47E-01	9.38E-01	9.38E-01	9.59E-01	9.46E-01	9.56E-01	9.63E-01
10 µg/ml QC	9.25E+00	9.52E+00	1.00E+01	9.36E+00	9.51E+00	9.75E+00	9.30E+00	9.34E+00	9.52E+0
1 µg/ml	9.17E-01	9.92E-01	1.02E+00	1.02E+00	1.02E+00	1.03E+00	1.03E+00	1.04E+00	1.04E+00
82B-6	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-7	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-8	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-9	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-10	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-11	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-12	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-13	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-14	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-15	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-16	ND	ND	ND	ND	ND	ND	ND	ND	ND
MeCl2	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	ND
0.1 µg/ml	1.02E-01	1.03E-01	1.04E-01	1.05E-01	1.05E-01	1.05E-01	1.04E-01	1.05E-01	1.04E-01
1 µg/ml	9.37E-01	9.76E-01	9.64E-01	9.70E-01	9.69E-01	9.62E-01	9.43E-01	9.54E-01	9.56E-01
82B-17	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-18	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-19	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-20	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-21	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-22	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-23	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-24	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-25	ND	ND	ND	ND	ND	ND	ND	ND	ND
82C-14	ND	ND	ND	ND	ND	ND	ND	ND	ND

Analyst: David A. Kovacs   BLQ < 0.01 µg/ml   Printed: 9/1/93

SR#SF Dr. Kampbell HIII AFB Core Extrac /MSD Analyses Units - .g

SAMPLE NAME	BENZENE	TOLUENE	EB	p-XYLENE	m-XYLENE	o-XYLENE	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB
82C-16	ND	ND	ND	ND	ND	ND	1.39E-02	1.67E-02	4.91E-03
10 µg/ml QC	9.52E+00	9.62E+00	1.00E+01	9.34E+00	9.53E+00	9.77E+00	9.41E+00	9.54E+00	9.76E+00
100 µg/ml	9.87E+01	1.03E+02	1.03E+02	1.05E+02	1.03E+02	1.03E+02	1.04E+02	1.04E+02	1.04E+02
82C-19	6.21E-03	BLQ	1.80E-02	4.20E-02	2.57E-02	1.51E-02	1.65E+00	1.16E+00	1.08E-01
82C-20	BLQ	1.76E-02	6.18E-03	2.96E-02	9.10E-03	4.01E-03	1.50E+00	1.03E+00	5.53E-02
82C-21	3.67E-03	1.92E-02	5.58E-03	3.65E-02	9.56E-03	BLQ	2.34E+00	2.04E+00	2.08E-01
82C-22	3.27E-03	2.00E-02	2.86E-02	8.57E-02	6.62E-02	BLQ	3.70E+00	4.42E+00	9.05E-01
82C-23	BLQ	BLQ	6.42E-03	1.10E-02	9.91E-03	BLQ	8.01E-02	7.41E-02	8.13E-03
82C-24	BLQ	BLQ	7.95E-03	1.05E-02	1.89E-02	BLQ	1.48E-02	1.68E-02	3.63E-03
82C-25	BLQ	BLQ	1.24E-02	2.21E-02	5.21E-02	1.36E-02	3.88E-02	5.40E-02	2.29E-02
82C-26	BLQ	BLQ	1.18E-02	1.78E-02	4.18E-02	7.16E-03	2.90E-02	3.71E-02	1.45E-02
82D-1	9.59E-03	BLQ	1.59E-02	BLQ	BLQ	BLQ	4.16E-03	BLQ	BLQ
82D-3	ND	BLQ	3.35E-03	BLQ	3.36E-03	BLQ	1.74E-02	8.85E-03	3.11E-03
82D-4	BLQ	BLQ	8.71E-03	1.36E-02	3.45E-02	4.51E-03	1.95E-01	2.25E-01	5.48E-02
MeCl2	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
Method Blank	ND	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
0.01 µg/ml	1.02E-02	9.59E-03	1.00E-02	1.02E-02	1.02E-02	9.83E-03	1.11E-02	1.02E-02	1.15E-02
0.1 µg/ml	9.87E-02	9.93E-02	9.87E-02	9.88E-02	9.86E-02	9.86E-02	9.85E-02	9.66E-02	9.52E-02
1 µg/ml	1.09E+00	1.01E+00	1.00E+00	1.00E+00	9.98E-01	9.95E-01	9.88E-01	9.91E-01	9.83E-01
82D-5	BLQ	BLQ	ND	BLQ	BLQ	BLQ	BLQ	4.98E-03	BLQ
82D-6	BLQ	BLQ	ND	ND	ND	ND	ND	ND	ND
82D-12	2.03E-02	BLQ	1.15E-01	4.64E-03	1.67E-02	BLQ	6.32E-03	4.16E-03	BLQ
82D-13	1.85E-02	BLQ	1.41E-01	7.55E-03	2.75E-02	4.76E-03	8.71E-03	5.72E-03	BLQ
82D-14•	2.09E-02	BLQ	1.24E-01	6.62E-02	1.94E-02	BLQ	6.37E-02	6.95E-02	5.18E-03
82D-15	3.43E-02	BLQ	8.78E-02	3.90E-02	1.21E-01	3.23E-02	4.33E-02	3.03E-02	1.27E-02
82D-16	3.16E-02	3.04E-03	6.13E-02	5.51E-02	1.81E-01	4.50E-02	3.65E-02	3.99E-02	2.13E-02
82D-17	6.30E-03	BLQ	2.13E-02	BLQ	BLQ	BLQ	1.47E-02	BLQ	ND
82D-18	7.92E-03	BLQ	3.44E-02	BLQ	BLQ	BLQ	2.58E-02	BLQ	ND
100 µg/ml	1.13E+02	1.08E+02	1.08E+02	1.08E+02	1.08E+02	1.08E+02	1.09E+02	1.09E+02	1.09E+02
10 µg/ml	1.10E+01	9.98E+00	9.96E+00	9.98E+00	1.00E+01	1.00E+01	1.00E+01	9.86E+00	9.95E+00
82D-19	8.29E-03	BLQ	6.04E-02	3.88E-02	5.29E-03	5.77E-03	8.82E-02	7.80E-02	8.21E-03
82D-21	1.04E-02	BLQ	9.49E-02	BLQ	3.03E-03	BLQ	4.77E-03	3.10E-03	ND
82D-22	6.97E-02	BLQ	1.11E-01	1.30E-02	BLQ	BLQ	3.04E-02	1.11E-02	BLQ
82D-23	2.71E-01	BLQ	1.48E+00	1.62E+00	3.40E+00	7.32E-01	2.53E+00	3.11E+00	8.17E-01

Analyst: David A. Kovacs BLQ < 0.01 µg/ml Printed: 9/1/93

SR#S Dr. Kampbell Hill AFB Core Extrac... GC/MSD Analyses Units = mg/kg

SAMPLE NAME	BENZENE	TOLUENE	EB	p-XYLENE	m-XYLENE	o-XYLENE	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB
82D-24	1.29E-01	BLQ	2.64E-01	2.76E-01	5.55E-01	1.44E-01	3.73E-01	4.40E-01	1.35E-01
82D-25	1.03E-02	BLQ	1.06E-02	5.75E-03	1.43E-02	3.59E-03	7.44E-03	7.02E-03	BLQ
82D-38	3.93E-02	8.09E-03	1.28E-01	1.05E-02	1.01E-01	6.92E-02	7.33E-02	1.07E-02	3.84E-02
82D-39	3.88E-02	BLQ	1.37E-01	BLQ	4.04E-03	4.86E-03	7.70E-03	BLQ	BLQ
82D-40	3.14E-02	BLQ	1.71E-01	3.78E-02	1.11E-01	2.42E-02	4.39E-02	3.73E-02	1.63E-02
82E-2	ND	ND	ND	ND	ND	ND	ND	ND	ND
1 µg/ml	1.05E+00	1.02E+00	9.94E-01	9.85E-01	9.93E-01	9.93E-01	1.02E+00	9.89E-01	1.00E+00
0.1 µg/ml	1.08E-01	1.03E-01	1.02E-01	1.01E-01	1.01E-01	9.99E-02	1.00E-01	9.91E-02	9.93E-0
82E-3	ND	ND	ND	ND	ND	ND	ND	ND	ND
82E-13	ND	ND	ND	ND	ND	ND	ND	ND	ND
82E-14	ND	ND	ND	ND	ND	ND	ND	ND	ND
82E-15	ND	ND	ND	ND	ND	ND	ND	ND	NC
82E-17	ND	ND	ND	ND	ND	ND	ND	ND	ND
82I-5	1.61E+00	2.04E-01	1.12E+01	2.34E+01	6.31E+01	1.99E+01	2.93E+01	5.09E+01	1.93E+01
MeCl2	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
333 µg/ml	3.49E+02	3.45E+02	3.44E+02	3.56E+02	3.45E+02	3.44E+02	3.43E+02	3.43E+02	3.42E+02
82I-15	5.01E-01	1.07E+00	3.72E+00	4.81E+00	1.05E+01	5.58E+00	2.94E+00	8.45E+00	2.03E+00
82I-16	3.33E-01	3.04E-01	1.12E+00	1.48E+00	1.83E+00	1.72E+00	8.57E-01	2.33E+00	6.72E-01
82I-17	6.53E-01	5.91E-01	3.39E+00	4.69E+00	4.89E+00	5.28E+00	3.04E+00	8.37E+00	2.34E+00
82I-18	6.29E-01	1.17E-01	1.31E+00	2.02E+00	9.88E-01	2.31E+00	1.62E+00	4.72E+00	1.25E+00
10 µg/ml QC	1.03E+01	9.15E+00	9.45E+00	8.67E+00	9.02E+00	9.17E+00	8.89E+00	9.01E+00	9.23E+00
100 µg/ml	1.00E+02	9.47E+01	9.40E+01	9.08E+01	9.39E+01	9.40E+01	9.51E+01	9.50E+01	9.50E+01
10 µg/ml	9.74E+00	9.81E+00	9.76E+00	1.02E+01	9.99E+00	1.00E+01	1.03E+01	1.02E+01	1.01E+0
1 µg/ml	9.89E-01	1.02E+00	1.02E+00	1.00E+00	1.01E+00	1.01E+00	1.08E+00	1.02E+00	1.01E+00
82I-19	6.78E-01	4.55E-02	1.60E-01	2.43E-01	5.17E-01	3.16E-01	8.43E-02	2.22E-01	7.78E-02
82I-20	5.38E-01	4.36E-02	1.52E-01	2.21E-01	6.04E-01	3.03E-01	7.47E-02	1.91E-01	7.09E-02
82I-21	6.65E-01	3.50E-02	1.59E-01	2.33E-01	6.12E-01	3.21E-01	7.96E-02	2.06E-01	7.83E-02
82I-22	7.71E-01	9.36E-02	1.50E-01	2.33E-01	6.21E-01	3.18E-01	9.38E-02	2.46E-01	8.99E-02
82I-23	1.45E+00	2.00E-01	2.83E-01	4.27E-01	1.16E+00	5.67E-01	1.57E-01	4.02E-01	1.55E-01
82I-24	7.87E-01	1.59E-01	1.50E-01	2.28E-01	6.16E-01	3.10E-01	7.43E-02	1.95E-01	7.49E-02
82I-25	8.66E-01	2.31E-01	1.87E-01	2.81E-01	8.02E-01	4.03E-01	1.03E-01	2.44E-01	9.09E-02
82I-26	7.49E-01	3.75E+00	1.03E+00	1.70E+00	4.74E+00	2.04E+00	1.24E+00	2.54E+00	9.58E-01
82I-27	4.90E-01	1.73E+00	3.77E-01	6.25E-01	1.84E+00	7.25E-01	3.84E-01	7.24E-01	2.72E-01
82I-28	BLQ	1.68E-02	BLQ	BLQ	8.84E-03	BLQ	BLQ	6.24E-03	BLQ

Analyst: David A. Kovacs BLQ < 0.01 µg/ml Printed: 9/1/93

SR#: Dr. Kampbell

Hill AFB Core Extrac… GC/MSD Analyses

Units = mg/kg

SAMPLE NAME	BENZENE	TOLUENE	EB	p-XYLENE	m-XYLENE	o-XYLENE	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB
1 μg/ml	1.01E+00	1.06E+00	1.02E+00	1.01E+00	1.01E+00	1.03E+00	1.08E+00	1.04E+00	1.01E+00
0.1 μg/ml	1.05E-01	1.03E-01	9.81E-02	9.95E-02	9.92E-02	9.70E-02	9.35E-02	9.11E-02	9.53E-02
821-29	BLQ	1.57E-02	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
821-30	BLQ	1.11E-02	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
821-31	BLQ	1.14E-02	1.01E-01	ND	1.28E-02	BLQ	BLQ	BLQ	BLQ
821-32	1.36E-02	3.20E-02	1.24E+00	1.05E+00	1.79E+00	BLQ	4.18E-01	1.91E-02	2.59E-01
821-33	BLQ	1.22E-02	2.71E+01	ND	ND	3.76E-02	1.31E+01	7.62E+00	3.09E+00
821-34	BLQ	7.30E-03	1.61E+01	ND	ND	ND	BLQ	BLQ	ND
821-35	8.31E-03	1.37E-02	BLQ	BLQ	ND	ND	ND	ND	ND
821-36	8.12E-02	1.54E-02	2.38E-02	3.64E-02	8.98E-02	BLQ	BLQ	BLQ	ND
821-37	7.12E-01	1.82E-01	2.72E+00	3.96E+00	7.86E+00	8.50E-02	1.21E-02	1.72E-02	9.37E-03
821-38	3.15E-01	1.88E-02	1.21E-01	1.54E-01	5.92E-02	4.79E+00	2.32E+00	5.38E+00	1.50E+00
821-39	4.22E-01	6.74E-02	1.31E+00	1.75E+00	2.28E+00	1.29E-01	3.10E-02	1.13E-01	3.10E-02
MeCl2	BLQ	BLQ	BLQ	BLQ	BLQ	1.03E+00	1.27E+00	3.30E+00	8.23E-01
Method Blank	ND	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
10 μg/ml QC	1.06E+01	1.06E+01	1.08E+01	1.04E+01	1.06E+01	BLQ	BLQ	BLQ	BLQ
100 μg/ml	1.07E+02	1.04E+02	1.04E+02	1.03E+02	1.04E+02	1.06E+01	1.04E+01	1.05E+01	1.06E+01
						1.04E+02	1.04E+02	1.04E+02	1.04E+02

Analyst: David A. Kovacs

BLQ < 0.01 μg/ml

 Printed: 9/1/93

Duplicate (incomplete)

SR#SF-^-5 Dr. Kampbell Hill AFB Core Extrac C/MSD Analyses Units = , .g

SAMPLE NAME	BENZENE	TOLUENE	EB	p-XYLENE	m-XYLENE	o-XYLENE	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB
82B-1	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-2	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-3	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-4	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-5	ND	ND	ND	ND	ND	ND	ND	ND	ND
0.01 µg/ml	1.31E-02	1.10E-02	1.13E-02	1.14E-02	1.13E-02	1.08E-02	1.35E-02	1.11E-02	1.25E-02
0.1 µg/ml	8.94E-02	9.36E-02	9.41E-02	9.38E-02	9.38E-02	9.45E-02	9.29E-02	9.34E-02	9.22E-02
1 µg/ml	9.58E-01	9.60E-01	9.47E-01	9.38E-01	9.38E-01	9.59E-01	9.46E-01	9.56E-01	9.63E-01
10 µg/ml QC	9.25E+00	9.52E+00	1.00E+01	9.36E+00	9.51E+00	9.75E+00	9.30E+00	9.34E+00	9.52E+00
1 µg/ml	9.17E-01	9.92E-01	1.02E+00	1.02E+00	1.02E+00	1.03E+00	1.03E+00	1.04E+00	1.04E+00
82B-6	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-7	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-8	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-9	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-10	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-11	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-12	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-13	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-14	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-15	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-16	ND	ND	ND	ND	ND	ND	ND	ND	ND
MeCl2	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	ND
0.1 µg/ml	1.02E-01	1.03E-01	1.04E-01	1.05E-01	1.05E-01	1.05E-01	1.04E-01	1.05E-01	1.04E-01
1 µg/ml	9.37E-01	9.76E-01	9.64E-01	9.70E-01	9.69E-01	9.62E-01	9.43E-01	9.54E-01	9.56E-01
82B-17	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-18	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-19	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-20	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-21	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-22	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-23	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-24	ND	ND	ND	ND	ND	ND	ND	ND	ND
82B-25	ND	ND	ND	ND	ND	ND	ND	ND	ND
82C-14	ND	ND	ND	ND	ND	ND	ND	ND	ND

Analyst: David A. Kovacs BLQ < 0.01 µg/ml

SAMPLE NAME	BENZENE	TOLUENE	EB	p-XYLENE	m-XYLENE	o-XYLENE	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB
82C-16	ND	ND	ND	ND	ND	ND	1.39E-02	1.67E-02	4.91E-03
10 µg/ml QC	9.52E+00	9.62E+00	1.00E+01	9.34E+00	9.53E+00	9.77E+00	9.41E+00	9.54E+00	9.76E+00
100 µg/ml	9.87E+01	1.03E+02	1.03E+02	1.05E+02	1.03E+02	1.03E+02	1.04E+02	1.04E+02	1.04E+02
82C-19	6.21E-03	BLQ	1.80E-02	4.20E-02	2.57E-02	1.51E-02	1.65E+00	1.16E+00	1.08E-01
82C-20	BLQ	1.76E-02	6.18E-03	2.96E-02	9.10E-03	4.01E-03	1.50E+00	1.03E+00	5.53E-02
82C-21	3.67E-03	1.92E-02	5.58E-03	3.65E-02	9.56E-03	BLQ	2.34E+00	2.04E+00	2.08E-01
82C-22	3.27E-03	2.00E-02	2.86E-02	8.57E-02	6.62E-02	BLQ	3.70E+00	4.42E+00	9.05E-01
82C-23	BLQ	BLQ	6.42E-03	1.10E-02	9.91E-03	BLQ	8.01E-02	7.41E-02	8.13E-03
82C-24	BLQ	BLQ	7.95E-03	1.05E-02	1.89E-02	BLQ	1.48E-02	1.68E-02	3.63E-03
82C-25	BLQ	BLQ	1.24E-02	2.21E-02	5.21E-02	1.36E-02	3.88E-02	5.40E-02	2.29E-02
82C-26	BLQ	BLQ	1.18E-02	1.78E-02	4.18E-02	7.16E-03	2.90E-02	3.71E-02	1.45E-02
82D-1	9.59E-03	BLQ	1.59E-02	BLQ	BLQ	BLQ	4.16E-03	BLQ	BLQ
82D-3	ND	BLQ	3.35E-03	BLQ	3.36E-03	BLQ	1.74E-02	8.85E-03	3.11E-03
82D-4	BLQ	BLQ	8.71E-03	1.36E-02	3.45E-02	4.51E-03	1.95E-01	2.25E-01	5.48E-02
MeCl2	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
Method Blank	ND	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
0.01 µg/ml	1.02E-02	9.59E-03	1.00E-02	1.02E-02	1.02E-02	9.83E-03	1.11E-02	1.02E-02	1.15E-02
0.1 µg/ml	9.87E-02	9.93E-02	9.87E-02	9.88E-02	9.86E-02	9.86E-02	9.85E-02	9.66E-02	9.52E-02
1 µg/ml	1.09E+00	1.01E+00	1.00E+00	1.00E+00	9.98E-01	9.95E-01	9.88E-01	9.91E-01	9.83E-01
82D-5	BLQ	BLQ	ND	BLQ	BLQ	BLQ	BLQ	4.98E-03	BLQ
82D-6	BLQ	BLQ	ND	ND	ND	ND	ND	ND	ND
82D-12	2.03E-02	BLQ	1.15E-01	4.64E-03	1.67E-02	BLQ	6.32E-03	4.16E-03	BLQ
82D-13	1.85E-02	BLQ	1.41E-01	7.55E-03	2.75E-02	4.76E-03	8.71E-03	5.72E-03	BLQ
82D-14	2.09E-02	BLQ	1.24E-01	6.62E-02	1.94E-02	BLQ	6.37E-02	6.95E-02	5.18E-03
82D-15	3.43E-02	BLQ	8.78E-02	3.90E-02	1.21E-01	3.23E-02	4.33E-02	3.03E-02	1.27E-02
82D-16	3.16E-02	3.04E-03	6.13E-02	6.51E-02	1.81E-01	4.50E-02	3.65E-02	3.99E-02	2.13E-02
82D-17	6.30E-03	BLQ	2.13E-02	BLQ	BLQ	BLQ	1.47E-02	BLQ	ND
82D-18	7.92E-03	BLQ	3.44E-02	BLQ	BLQ	BLQ	2.58E-02	BLQ	ND
100 µg/ml	1.13E+02	1.08E+02	1.08E+02	1.08E+02	1.08E+02	1.08E+02	1.09E+02	1.09E+02	1.09E+02
10 µg/ml	1.10E+01	9.98E+00	9.96E+00	9.98E+00	1.00E+01	1.00E+01	1.00E+01	9.86E+00	9.95E+00
82D-19	8.29E-03	BLQ	6.04E-02	3.88E-02	5.29E-03	5.77E-03	8.82E-02	7.80E-02	8.21E-03
82D-21	1.04E-02	BLQ	9.49E-02	BLQ	3.03E-03	BLQ	4.77E-03	3.10E-03	ND
82D-22	6.97E-02	BLQ	1.11E-01	1.30E-02	BLQ	BLQ	3.04E-02	1.11E-02	BLQ
82D-23	2.71E-01	BLQ	1.48E+00	1.62E+00	3.40E+00	7.32E-01	2.53E+00	3.11E+00	8.17E-01

Analyst: David A. Kovacs   BLQ < 0.01 µg/ml

SAMPLE NAME	BENZENE	TOLUENE	EB	p-XYLENE	m-XYLENE	o-XYLENE	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB
82D-24	1.29E-01	BLQ	2.64E-01	2.76E-01	5.55E-01	1.44E-01	3.73E-01	4.40E-01	1.35E-01
82D-25	1.03E-02	BLQ	1.06E-02	5.75E-03	1.43E-02	3.59E-03	7.44E-03	7.02E-03	BLQ
82D-38	3.93E-02	8.09E-03	1.28E-01	1.05E-02	1.01E-01	6.92E-02	7.33E-02	1.07E-02	3.84E-02
82D-39	3.88E-02	BLQ	1.37E-01	BLQ	4.04E-03	4.86E-03	7.70E-03	BLQ	BLQ
82D-40	3.14E-02	BLQ	1.71E-01	3.78E-02	1.11E-01	2.42E-02	4.39E-02	3.73E-02	1.63E-02
82E-2	ND	ND	ND	ND	ND	ND	ND	ND	ND
1 µg/ml	1.05E+00	1.02E+00	9.94E-01	9.85E-01	9.93E-01	9.93E-01	1.02E+00	9.89E-01	1.00E+00
0.1 µg/ml	1.08E-01	1.03E-01	1.02E-01	1.01E-01	1.01E-01	9.99E-02	1.00E-01	9.91E-02	9.93E-02
82E-3	ND	ND	ND	ND	ND	ND	ND	ND	ND
82E-13	ND	ND	ND	ND	ND	ND	ND	ND	ND
82E-14	ND	ND	ND	ND	ND	ND	ND	ND	ND
82E-15	ND	ND	ND	ND	ND	ND	ND	ND	ND
82E-17	ND	ND	ND	ND	ND	ND	ND	ND	ND
82I-5	1.61E+00	2.04E-01	1.12E+01	2.34E+01	6.31E+01	1.99E+01	2.93E+01	5.09E+01	1.93E+01
MeCl2	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
333 µg/ml	3.49E+02	3.45E+02	3.44E+02	3.56E+02	3.45E+02	3.44E+02	3.43E+02	3.43E+02	3.42E+02
82I-15	5.01E-01	1.07E+00	3.72E+00	4.81E+00	1.05E+01	5.58E+00	2.94E+00	8.45E+00	2.03E+00
82I-16	3.33E-01	3.04E-01	1.12E+00	1.48E+00	1.83E+00	1.72E+00	8.57E-01	2.33E+00	6.72E-01
82I-17	6.53E-01	5.91E-01	3.39E+00	4.69E+00	4.89E+00	5.28E+00	3.04E+00	8.37E+00	2.34E+00
82I-18	6.29E-01	1.17E-01	1.31E+00	2.02E+00	9.88E-01	2.31E+00	1.62E+00	4.72E+00	1.25E+00
10 µg/ml QC	1.03E+01	9.15E+00	9.45E+00	8.67E+00	9.02E+00	9.17E+00	8.89E+00	9.01E+00	9.23E+00
100 µg/ml	1.00E+02	9.47E+01	9.40E+01	9.08E+01	9.39E+01	9.40E+01	9.51E+01	9.50E+01	9.50E+01
10 µg/ml	9.74E+00	9.81E+00	9.76E+00	1.02E+01	9.99E+00	1.00E+01	1.03E+01	1.02E+01	1.01E+01
1 µg/ml	9.89E-01	1.02E+00	1.02E+00	1.00E+00	1.01E+00	1.01E+00	1.08E+00	1.02E+00	1.01E+00
82I-19	6.78E-01	4.55E-02	1.60E-01	2.43E-01	5.17E-01	3.16E-01	8.43E-02	2.22E-01	7.78E-02
82I-20	5.38E-01	4.36E-02	1.52E-01	2.21E-01	6.04E-01	3.03E-01	7.47E-02	1.91E-01	7.09E-02
82I-21	6.65E-01	3.50E-02	1.59E-01	2.33E-01	6.12E-01	3.21E-01	7.98E-02	2.06E-01	7.83E-02
82I-22	7.71E-01	9.36E-02	1.50E-01	2.33E-01	6.21E-01	3.18E-01	9.38E-02	2.46E-01	8.99E-02
82I-23	1.45E+00	2.00E-01	2.83E-01	4.27E-01	1.16E+00	5.67E-01	1.57E-01	4.02E-01	1.55E-01
82I-24	7.87E-01	1.59E-01	1.50E-01	2.28E-01	6.16E-01	3.10E-01	7.43E-02	1.95E-01	7.49E-02
82I-25	8.66E-01	2.31E-01	1.87E-01	2.81E-01	8.02E-01	4.03E-01	1.03E-01	2.44E-01	9.09E-02
82I-26	7.49E-01	3.75E+00	1.03E+00	1.70E+00	4.74E+00	2.04E+00	1.24E+00	2.54E+00	9.58E-01
82I-27	4.90E-01	1.73E+00	3.77E-01	6.25E-01	1.84E+00	7.25E-01	3.84E-01	7.24E-01	2.72E-01
82I-28	BLQ	1.68E-02	BLQ	BLQ	8.84E-03	BLQ	BLQ	6.24E-03	BLQ

Analyst: David A. Kovacs

BLQ < 0.01 µg/ml

SAMPLE NAME	BENZENE	TOLUENE	EB	p-XYLENE	m-XYLENE	o-XYLENE	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB
1 µg/ml	1.01E+00	1.05E+00	1.02E+00	1.01E+00	1.01E+00	1.03E+00	1.08E+00	1.04E+00	1.01E+00
0.1 µg/ml	1.05E-01	1.03E-01	9.81E-02	9.95E-02	9.92E-02	9.70E-02	9.35E-02	9.11E-02	9.53E-02
82I-29	BLQ	1.57E-02	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
82I-30	BLQ	1.11E-02	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
82I-31	BLQ	1.14E-02	1.01E-01	ND	1.28E-02	BLQ	4.18E-01	1.91E-02	2.59E-01
82I-32	1.36E-02	3.20E-02	1.24E+00	1.05E+00	1.79E+00	3.76E-02	1.31E+01	7.62E+00	3.09E+00
82I-33	BLQ	1.22E-02	2.71E+01	ND	ND	ND	BLQ	BLQ	ND
82I-34	BLQ	7.30E-03	1.61E+01	ND	ND	ND	ND	ND	ND
82I-35	8.31E-03	1.37E-02	BLQ	BLQ	ND	BLQ	BLQ	BLQ	ND
82I-36	8.12E-02	1.54E-02	2.38E-02	3.64E-02	8.98E-02	8.50E-02	1.21E-02	1.72E-02	9.37E-03
82I-37	7.12E-01	1.82E-01	2.72E+00	3.96E+00	7.86E+00	4.79E+00	2.32E+00	5.38E+00	1.50E+00
82I-38	3.15E-01	1.88E-02	1.21E-01	1.54E-01	5.92E-02	1.29E-01	3.10E-02	1.13E-01	3.10E-02
82I-39	4.22E-01	6.74E-02	1.31E+00	1.75E+00	2.28E+00	1.03E+00	1.27E+00	3.30E+00	8.23E-01
MeCl2	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
Method Blank	ND	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
10 µg/ml QC	1.06E+01	1.06E+01	1.08E+01	1.04E+01	1.06E+01	1.06E+01	1.04E+01	1.05E+01	1.06E+01
100 µg/ml	1.07E+02	1.04E+02	1.04E+02	1.03E+02	1.04E+02	1.04E+02	1.04E+02	1.04E+02	1.04E+02

Analyst: David A. Kovacs BLQ < 0.01 µg/ml

MANAGEMENT TECHNOLOGY

Ref: 93-DK8/vg

October 21, 1993

Dr. John T. Wilson
R.S. Kerr Environmental Research Lab
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

THRU: S.A. Vandegrift SAV

Dear John:

Please find attached results of GC/MSD analysis of Hill AFB core extracts for quantitation of Benzene, Toluene, Ethylbenzene (EB), p-Xylene, m-Xylene, o-Xylene, 1,3,5-Trimethylbenzene (1,3,5-TMB), 1,2,4-Trimethylbenzene (1,2,4-TMB) and 1,2,3-Trimethylbenzene (1,2,3-TMB) as requested under Service Request #SF-0-26.

The analytical method was a modification of RSKSOP-124. Cool (38°C) on-column injection (0.5 µl) was used with electronic pressure control (EPC) set for a constant flow of 0.9 ml/min. A 30M X 0.25 mm Restek Stabilwax (Crossbonded Carbowax-PEG, 0.5 µm film) capillary GC column with 1 foot long X 0.53 mm ID uncoated capillary precolumn was used. Quantification was based on two standard curves: A low level curve was used for extract concentrations in the range 0.01-1.0 µg/ml (0.01, 0.1, 1.0 µg/ml). The second curve was used for quantification of concentrations >1.0 (1, 10, 100 µg/ml).

If you require further information, please feel free to contact me.

Sincerely,

David A. Kovacs

David A. Kovacs

xc: R.L. Cosby
J.L. Seeley
G. Smith

Service Request SF-0-26 Dr. Wilson | Hill AFB Core Extracts GC/MSD Analyses | Units = mg/kg

SAMPLE	BENZENE	TOLUENE	EB	p-XYLENE	m-XYLENE	o-XYLENE	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB
100 µg/ml QC	9.78E+01	9.29E+01	9.24E+01	9.39E+01	9.22E+01	9.22E+01	9.40E+01	9.19E+01	9.15E+01
1 µg/ml	1.05E+00	1.06E+00	1.03E+00	1.03E+00	1.03E+00	1.03E+00	1.06E+00	1.03E+00	1.07E+00
821-1	BLQ	1.42E-01	5.56E-01	1.22E+00	3.67E+00	1.61E+00	2.30E+00	4.43E+00	1.71E+00
821-2	4.01E-01	1.26E+01	1.75E+01	3.44E+01	9.93E+01	3.66E+01	3.68E+01	6.98E+01	2.53E+01
821-3	4.55E+00	2.73E+00	4.77E+01	1.05E+02	2.84E+02	1.00E+02	8.88E+01	1.87E+02	5.92E+01
821-4	5.17E-01	2.35E-01	4.83E+00	2.23E+01	6.23E+01	2.08E+01	2.33E+01	4.27E+01	1.54E+01
821-5	3.26E-02	2.66E-02	1.45E+01	1.99E+01	5.27E+01	1.82E+01	2.81E+01	4.99E+01	1.85E+01
821-6	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
821-7	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
821-8	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	ND
821-9	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
821-10	ND	BLQ	BLQ	BLQ	4.08E-03	BLQ	BLQ	BLQ	BLQ
1 µg/ml	9.73E-01	1.06E+00	1.06E+00	1.06E+00	1.05E+00	1.05E+00	1.06E+00	1.08E+00	1.07E+00
0.1 µg/ml	1.04E-01	1.04E-01	9.74E-02	9.63E-02	9.86E-02	9.93E-02	1.01E-01	1.04E-01	1.09E-01
821-11	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
821-12	BLQ	BLQ	BLQ	BLQ	5.43E-03	BLQ	BLQ	BLQ	BLQ
821-13	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	ND
821-14	ND	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
Method Blank	ND	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
1 µg/ml	1.05E+00	1.06E+00	1.03E+00	1.03E+00	1.03E+00	1.03E+00	1.06E+00	1.03E+00	1.07E+00

Analyst: David A. Kovacs | BLQ < 0.01 µg/ml | Page 1 of 1 Printed: 10/21/93

Ref: 93-RC13/vg

September 21, 1993

Dr. John Wilson
R.S. Kerr Environmental Research Lab
U.S. Environmental Protection Agency
Post Office Box 1198
Ada, OK 74820

THRU: S.A. Vandegrift SAV

Dear John:

Attached is a report of the data generated from the analyses of 143 sample core extracts from Hill AFB, UT. The extracts, which were submitted under Service Request #SF-0-5, were analyzed for total fuel content as JP-4 jet fuel only. The reported values for fuel carbon were computed from the JP-4 determinations. I have also attached a report of the quality control analyses that were performed concurrently with the sample analyses.

Data quantification, peak identification, component concentration calculations, and dilution factor corrections were performed by MAXIMA chromatography software. JP-4 data was quantified with a 7-point external standard calibration curve ranging from 50 - 50,000 ng/µl.

The Minimum Detectable Limit (MDL) for JP-4 is determined by the concentration of the lowest calibration standard, which is 50 ng/µl. Since the MDL is determined by a calibration standard, it may also be defined as the Minimum Quantifiable Limit (MQL). It is important to note that values less than the MQL are reported in this data set, but cannot be considered quantified since they lie outside the range of the standard curve. All such unquantified data are approximations extrapolated from the JP-4 standard curve.

The samples from Service Request #SF-0-5 had an average mass of 14.68 g, and were extracted with 5.0 ml of methylene chloride. For simplicity's sake, I have assumed complete extraction of the sample's contents into the 5.0 ml of solvent.

In order to compute the MQL of JP-4 in the average sample core, assume the following:

Sample mass = 14.68 g
Extract volume = 5.0 ml
Extraction efficiency = 100%
Determined mass of JP-4 = 50 ng
(in 1.0 µl of extract)

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P.O. Box 12313, 2 Triangle Drive, Research Triangle Park, North Carolina 27709 919-549-0611 FAX 919-549-4665

Computation of the total mass of JP-4 in 5.0 ml of extract is as follows:

1. $\left(\frac{50\ \cancel{ng}}{1.0\ \cancel{\mu l}}\right) \left(\frac{1000\ \cancel{\mu l}}{\cancel{ml}}\right) \left(\frac{1\ \mu g}{1000\ \cancel{ng}}\right)\ 5.0\ \cancel{ml} = 250\ \mu g$

Consider that 22.28 g of sample was extracted with the 5.0 ml aliquot of methylene chloride and the original concentration is computed by division of the extracted mass of JP-4 by the sample mass:

2. $\frac{250\ \mu g}{14.68\ g} = 17.03\ \mu g/g$

Therefore, 17.03 $\mu g/g$ (or mg/kg, or ppm if you prefer either of these units) is the Minimum Quantifiable Limit (MQL) of JP-4 determined in these samples.

It should be realized that JP-4 determinations are based on the summation of multiple peak areas detected over a defined period of time rather than the area of a specific peak, which is typical of individual fuel component determinations. When using this method of determination, it is entirely possible for a single peak or a group of peaks not attributable to JP-4 to register enough area to be mistakenly represented as JP-4.

Sample extracts were received from Mark Blankenship on August 26, 1993. Analyses were started on August 26, 1993, and concluded on September 16, 1993. Sample extracts and quality control samples were analyzed according to RSKSOP-72, Rev. No. 1, excepting the modifications listed in the attached outline.

If you have any questions concerning this report, please contact me at your convenience.

Sincerely,

Randy Callaway

Randy Callaway

xc: R.L. Cosby
J.L. Seeley

Hill AFB Field Data Number 2		
Sample	Depth (ft)	JP-4 (mg/kg)
82 I-14 TO 82 I-8	13.8-16.28	1.2 to 0.73
82 I-7	16.28-16.64	2.4
82 I-6	16.64-17.00	30.4
8a I-5	17.0-17.36	5330 and 4330
82 I-4	17.36-17.72	3770
82 I-3	17.72-18.08	14800
82 I-2	18.08-18.44	5870
82 I-1	18.44-18.80	398
82 I-27	18.8-19.12	67.30
82 I-26	19.12-19.45	276.00
82 I-25	19.45-19.77	17.60
82 I-24	19.77-20.09	14.30
82 I-23	20.09-20.42	24.00
82 I-22	20.42-20.74	17.90
82 I-21 TO 82 I-19	20.74-21.71	12.36
82 I-18	21.71-22.03	720.00
82 I-17	22.03-22.35	1290.00
82 I-16	22.35-22.68	385.00
82 I-15	22.68-23.00	1190.00
82 I-39	23.0-23.2	485.00
82 I-38	23.2-23.4	8.06
82 I-37	23.4-23.76	1370.00
82 I-36	23.76-24.12	4.20
82 I-35	24.12-24.48	4.96
82 I-34	24.48-24.89	2.87
82 I-33	24.89-25.20	4.43
82 I-32	25.20-25.56	3830.00
82 I-31	25.56-25.92	834.00
82 I-30 TO 82 I-28	25.92-27.00	5.96

Hill AFB Field Data Number 2		
Sample	Depth (ft)	TPH (mg/kg)
82 I-14 TO 82 I-8	13.8-16.28	<10
82 I-7	16.28-16.64	138
82 I-6	16.64-17.00	139
8a I-5	17.0-17.36	3530
82 I-4	17.36-17.72	11500
82 I-3	17.72-18.08	28300
82 I-2	18.08-18.44	5160
82 I-1	18.44-18.80	6080
82 I-27	18.8-19.12	<10
82 I-26	19.12-19.45	<10
82 I-25	19.45-19.77	<10
82 I-24	19.77-20.09	<10
82 I-23	20.09-20.42	<10
82 I-22	20.42-20.74	<10
82 I-21 TO 82 I-19	20.74-21.71	<10
82 I-18	21.71-22.03	276
82 I-17	22.03-22.35	856±80
82 I-16	22.35-22.68	<10
82 I-15	22.68-23.00	643
82 I-39	23.0-23.2	<10
82 I-38	23.2-23.4	<10
82 I-37	23.4-23.76	340
82 I-36	23.76-24.12	<10
82 I-35	24.12-24.48	<10
82 I-34	24.48-24.89	<10
82 I-33	24.89-25.20	<10
82 I-32	25.20-25.56	410±256
82 I-31	25.56-25.92	<10
82 I-30 TO 82 I-28	25.92-27.00	<10

Hill AFB Field Data Number 2		
Sample	Depth (ft)	JP-4 (mg/kg)
82 C-1	14.0	
82 C-2	13.5	
82 C-3	18.1	
82 C-4	17.8	
82 C-5	17.5	
82 C-6	17.2	
82 C-7	16.9	
82 C-8	16.6	
82 C-9	16.3	
82 C-10	16.0	
82 C-11	15.7	
82 C-12	15.4	
82 C-13	22.9	
82 C-14	22.6	0.62
82 C-15	skipped	
82 C-16	22.3	1.01
82 C-17	22.1	
82 C-18	broke	
82 C-19	22.0	638.0
82 C-20	21.7	593.0
82 C-21	21.55	698.0
82 C-22	21.4	820.0
82 C-23	21.1	26.0
82 C-24	20.8	1.02
82 C-25	20.5	2.88
82 C-26	20.2	1.95

Hill AFB Field Data Number 2		
Sample	Depth (ft)	TPH (mg/kg)
82 C-1	14.0	
82 C-2	13.5	
82 C-3	18.1	
82 C-4	17.8	
82 C-5	17.5	
82 C-6	17.2	
82 C-7	16.9	
82 C-8	16.6	
82 C-9	16.3	
82 C-10	16.0	
82 C-11	15.7	
82 C-12	15.4	
82 C-13	22.9	
82 C-14	22.6	<10
82 C-15	skipped	
82 C-16	22.3	<10
82 C-17	22.1	<10
82 C-18	broke	
82 C-19	22.0	444
82 C-20	21.7	530±14
82 C-21	21.55	173
82 C-22	21.4	352
82 C-23	21.1	<10
82 C-24	20.8	<10
82 C-25	20.5	<10
82 C-26	20.2	<10

(24)

SR&SF-0-5 / Kampbell / Hill AFB all conc. are ug/g

Sample I.D.	Dilution Factor	JP-4	Fuel Carbon (JP-4 x 0.85)
82 A1	1	1.14	0.97
82 A2	1	0.79	0.67
82 A3	1	0.50	0.43
82 A4	1	0.68	0.58
82 A5	1	0.93	0.79
82 A6	1	0.73	0.62
82 A7	1	0.83	0.70
82 A8	1	1.36	1.16
82 A9	1	0.49	0.41
82 A10	1	1.71	1.45
82 A11	1	1.30	1.11
82 A12	1	1.63	1.39
82 A13	1	0.68	0.58
82 A14	1	0.99	0.84
82 A15	1	1.25	1.06
82 A16	1	0.81	0.69
82 A17	1	0.97	0.83
82 A18	1	2.72	2.31
82 A19	1	0.64	0.54
82 A20	1	0.76	0.65
82 A21	1	1.23	1.05
82 A22	1	0.79	0.67
82 A23	1	0.97	0.82
82 A24	1	0.76	0.65
82 A25	1	0.70	0.59
82 A26	1	0.97	0.83
82 A27	1	0.68	0.58
82 A28	1	0.78	0.66
82 A29	1	1.03	0.88
82 A30	1	1.52	1.29
82 A31	1	0.72	0.61
82 A32	1	1.55	1.32
82 A33	1	0.83	0.71
82 A34	1	0.76	0.64
82 A35	1	0.53	0.45
82 A36	1	0.98	0.84
82 A37	1	0.49	0.42
82 A38	1	0.47	0.40
82 A39	1	0.52	0.45
82 A40	1	0.45	0.38
82 A41	1	0.84	0.72
82 A42	1	3.37	2.86
82 A43	1	0.86	0.73
82 A44	1	0.74	0.63
82 A45	1	1.40	1.19
82 A46	1	2.59	2.20
82 A47	1	2.01	1.71
82 A48	1	1.54	1.31
82 A49	1	0.98	0.83
82 A50	1	0.52	0.45
82 A51	1	0.56	0.47
82 A52	1	0.83	0.71
82 A53	1	0.68	0.58
82 A54	1	1.11	0.94
82 A55	1	0.43	0.37

NOTE: all reported values are corrected for dilution factors where applicable

SR#SF-0-5 / Kampbell / Hil. AFB all conc. are ug/g

Sample I.D.	Dilution Factor	JP-4	Fuel Carbon (JP-4 x 0.85)
82 B1	1	4.22	3.59
82 B2	1	1.53	1.30
82 B3	1	1.49	1.27
82 B4	1	1.06	0.90
82 B5	1	1.17	1.00
82 B6	1	1.16	0.99
82 B7	1	1.26	1.07
82 B8	1	1.61	1.37
82 B9	1	1.35	1.15
82 B10	1	1.09	0.93
82 B11	1	1.15	0.98
82 B12	1	1.44	1.22
82 B13	1	1.27	1.08
82 B14	1	1.52	1.29
82 B15	1	1.04	0.88
82 B16	1	0.83	0.71
82 B17	1	0.58	0.50
82 B18	1	0.69	0.59
82 B19	1	0.99	0.85
82 B20	1	0.71	0.60
82 B21	1	0.95	0.81
82 B22	1	1.31	1.11
82 B23	1	1.16	0.99
82 B24	1	0.66	0.56
82 B25	1	1.20	1.02
82 C14	1	0.62	0.53
82 C16	1	1.01	0.86
82 C19	1	638.00	542.00
82 C20	1	593.00	504.00
82 C21	1	698.00	593.00
82 C22	1	820.00	697.00
82 C23	1	26.00	22.10
82 C24	1	1.02	0.87
82 C25	1	2.88	2.45
82 C26	1	1.95	1.66
82 D1	1	1.12	0.95
82 D3	1	1.93	1.64
82 D4	1	79.60	67.70
82 D5	1	0.81	0.69
82 D6	1	0.76	0.64
82 D12	1	3.09	2.63
82 D13	1	3.38	2.87
82 D14	1	3.25	2.76
82 D15	1	2.41	2.05
82 D16	1	2.67	2.27
82 D17	1	0.56	0.48
82 D18	1	1.92	1.63
82 D19	1	2.72	2.31
82 D21	1	1.83	1.56
82 D22	1	2.22	1.89
82 D23	1	572.00	486.00
82 D24	1	77.10	65.50
82 D25	1	1.69	1.44
82 D38	1	3.96	3.37
82 D39	1	4.12	3.50
82 D40	1	6.12	5.20

NOTE: all reported values are corrected for dilution factors where applicable

SR#SF-0-5 / Kampbell / Hill AFB all conc. are ug/g

Sample I.D.	Dilution Factor	JP-4	Fuel Carbon (JP-4 x 0.85)
82 E2	1	4.12	3.50
82 E3	1	7.17	6.09
82 E13	1	5.25	4.46
82 E14	1	1.49	1.27
82 E15	1	1.29	1.10
82 E17	1	1.89	1.61
82 I5	1	5330.00	4530.00
82 I15	1	1190.00	1010.00
82 I16	1	385.00	327.00
82 I17	1	1290.00	1100.00
82 I18	1	720.00	612.00
82 I19	1	15.00	12.80
82 I20	1	12.10	10.30
82 I21	1	11.80	10.00
82 I22	1	17.90	15.20
82 I23	1	24.00	20.40
82 I24	1	14.30	12.20
82 I25	1	17.60	15.00
82 I26	1	276.00	235.00
82 I27	1	67.30	57.20
82 I28	1	5.24	4.45
82 I29	1	5.76	4.90
82 I30	1	6.89	5.86
82 I31	1	834.00	709.00
I32	1	3830.00	3260.00
2 I33	1	4.43	3.77
2 I34	1	2.87	2.44
82 I35	1	4.96	4.22
82 I36	1	4.20	3.57
82 I37	1	1370.00	1160.00
82 I38	1	8.06	6.85
82 I39	1	485.00	412.00

NOTE: all reported values are corrected for dilution factors where applicable

SR#SF-0-5 / Kampbell / QC Table all conc. are ng/ul

Sample I.D.	Date	JP-4
blk MeCl2	26AUG93	1.17
100 jp4		101.00
500 jp4		493.00
1000 jp4		963.00
5000 jp4		5190.00
10000 jp4		10200.00
50000 jp4		49000.00
blk MeCl2	31AUG93	1.61
Method blank #1		8.61
50 jp4		53.80
500 jp4		492.00
1000 jp4		946.00
5000 jp4		5190.00
10000 jp4		10400.00
50000 jp4		50700.00
blk MeCl2	14SEP93	1.45
Method blank #2		1.72
50 jp4		51.90
500 jp4		482.00
1000 jp4		966.00
5000 jp4		4750.00
10000 jp4		9060.00
50000 jp4		46900.00

blk MeCl2 = methylene chloride solvent blank
jp4 = JP-4 fuel standard (ng/ul)

I. HP5890 GC - (ERATING CONDITIONS
   A. Instrument Control
      1. Analyses: "SH-2-JP4"
      2. Program: "RWC-AS10"
      3. Calibration: "DK-5-BTEX"
   B. Temperature Program
      1. Initial Temp & Time: 10°C for 3.00 min
      2. Level 1: Rate = 4°C/min to 70°C, Final Time = 0.00
      3. Level 2: Rate = 10°C/min to 270°C, Final Time = 2.00
      4. Run Time: 40.00 min
      5. Oven Equilibration Time: 1.00 min
   C. Miscellaneous
      1. Peak Width: 0.02
      2. Attentuation: 2^5
      3. Chart Speed: 0.50
      4. Threshold = 0
      5. Offset = 10%

II. MAXIMA PEAK INTEGRATION
   A. Peak Detection Parameters
      1. Baseline Points: 18
      2. Filter Window (in points): 9
      3. Intg. Sensitivity (coarse): 10.50 µV/sec
      4. Intg. Sensitivity (fine): 5.00 µV/sec
      5. Skim Ratio: 100.00
   B. Peak Rejection Criteria
      1. Minimum Area: 2000 µV-sec
      2. Minimum Height: 300.0 µV
      3. Minimum Width: 3.00 sec
   C. Integration Events
      1. 0.00: Disable Peak Skimming
      2. 0.00: Disable Peak Detection
      3. 5.00: Enable Peak Detection
      4. 5.12: Set Baseline
      5. 5.50: Set Baseline
      6. 5.77: Set Baseline
      7. 7.60: Set Baseline
      8. 18.25: Set Baseline
      9. 21.78: Set Baseline
      10. 24.84: Set Baseline
      11. 27.61: Set Baseline
      12. 30.16: Set Baseline
      13. 32.85: Set Baseline
      14. 34.65: Set Baseline
      15. 35.93: Set Baseline
      16. 39.54: Set Baseline

IV. MAXIMA DATA ACQUISITION
   A. Preacquisition Delay: 5.00 min
   B. Duration: 35.00 min
   C. Rate: 3.00 points/sec
   D. Run Time: 40.00 min

V. MAXIMA CALIBRATION CURVES
   A. JP-4
      1. Calibration Range = 50 - 50,000 ng/µl
      2. Summation of all peaks detected from 5.00 - 40.00 minutes

MANAGEMENT TECHNOLOGY

Ref: 93-RC16/vg

October 20, 1993

Dr. John Wilson
R.S. Kerr Environmental Research Lab
U.S. Environmental Protection Agency
Post Office Box 1198
Ada, OK 74820

THRU: S.A. Vandegrift SAV

Dear John:

Attached is a report of the data generated from the analyses of 14 sample core extracts from Hill AFB, UT. The extracts, which were submitted under Service Request #SF-0-26, were analyzed for total fuel content as JP-4 jet fuel only. The reported values for fuel carbon were computed from the JP-4 determinations. I have also attached a report of the quality control analyses that were performed concurrently with the sample analyses.

Data quantification, peak identification, component concentration calculations, and dilution factor corrections were performed by MAXIMA chromatography software. JP-4 data was quantified with a 7-point external standard calibration curve ranging from 50 - 50,000 ng/µl.

The Minimum Detectable Limit (MDL) for JP-4 is determined by the concentration of the lowest calibration standard, which is 50 ng/µl. Since the MDL is determined by a calibration standard, it may also be defined as the Minimum Quantifiable Limit (MQL). It is important to note that values less than the MQL are reported in this data set, but cannot be considered quantified since they lie outside the range of the standard curve. All such unquantified data are approximations extrapolated from the JP-4 standard curve.

The samples from Service Request #SF-0-26 had an average mass of 15.23 g, and were extracted with 5.0 ml of methylene chloride. For simplicity's sake, I have assumed complete extraction of the sample's contents into the 5.0 ml of solvent.

In order to compute the MQL of JP-4 in the average sample core, assume the following:

Sample mass = 15.23 g
Extract volume = 5.0 ml
Extraction efficiency = 100%
Determined mass of JP-4 = 50 ng
(in 1.0 µl of extract)

ManTech Environmental Technology, Inc.

P.O. Box 12313, 2 Triangle Drive, Research Triangle Park, North Carolina 27709 919-549-0611 FAX 919-549-4665

Computation of the total mass of JP-4 in 5.0 ml of extract is as follows:

1. $$\left(\frac{50\ \cancel{ng}}{1.0\ \cancel{\mu l}}\right)\left(\frac{1000\ \cancel{\mu l}}{\cancel{ml}}\right)\left(\frac{1\ \mu g}{1000\ \cancel{ng}}\right)\ \underline{5.0\ \cancel{ml}} = 250\ \mu g$$

Consider that 22.28 g of sample was extracted with the 5.0 ml aliquot of methylene chloride and the original concentration is computed by division of the extracted mass of JP-4 by the sample mass:

2. $$\frac{250\ \mu g}{15.23\ g} = 16.41\ \mu g/g$$

Therefore, 16.41 µg/g (or mg/kg, or ppm if you prefer either of these units) is the Minimum Quantifiable Limit (MQL) of JP-4 determined in these samples.

It should be realized that JP-4 determinations are based on the summation of multiple peak areas detected over a defined period of time rather than the area of a specific peak, which is typical of individual fuel component determinations. When using this method of determination, it is entirely possible for a single peak or a group of peaks not attributable to JP-4 to register enough area to be mistakenly represented as JP-4.

Sample extracts were received from Mark Blankenship on October 15, 1993. Analyses were started on October 18, 1993, and concluded on October 19, 1993. Sample extracts and quality control samples were analyzed according to RSKSOP-72, Rev. No. 1, excepting the modifications listed in the attached outline.

If you have any questions concerning this report, please contact me at your convenience.

Sincerely,

Randy Callaway

Randy Callaway

xc: R.L. Cosby
J.L. Seeley

SR#SF-0-26 / Wilson / Mil 7B all conc. are ug/g

Sample I.D.	Dilution Factor	JP-4	Fuel Carbon (JP-4 x 0.85)
82 I1	1	398.00	338.00
82 I2	1	5870.00	4990.00
82 I3	10	14800.00	12600.00
82 I4	1	3770.00	3200.00
82 I5	1	4330.00	3680.00
82 I6	1	30.40	25.80
82 I7	1	2.35	2.00
82 I8	1	0.73	0.62
82 I9	1	0.84	0.72
82 I10	1	0.86	0.73
82 I11	1	0.83	0.71
82 I12	1	0.88	0.75
82 I13	1	1.24	1.05
82 I14	1	0.98	0.83

NOTE: all reported values are corrected for dilution factors where applicable

SR#SF-0-26 / Wilson / QC T : all conc. are ng/ul

Sample I.D.	Date	JP-4
blk MeCl2	18OCT93	1.70
Method blank		2.21
500 jp4		520.00
5000 jp4		4880.00
50000 jp4		47400.00
blk MeCl2	21OCT93	2.96
1000 jp4		976.00
10000 jp4		9130.00

blk MeCl2 = methylene chloride solvent blank
jp4 = JP-4 fuel standard (ng/ul)

I. HP5890 GC · PERATING CONDITIONS
   A. Instrument Control
      1. Analyses: "SH-2-JP4"
      2. Program: "RWC-AS10"
      3. Calibration: "DK-5-BTEX"
   B. Temperature Program
      1. Initial Temp & Time: 10°C for 3.00 min
      2. Level 1: Rate = 4°C/min to 70°C, Final Time = 0.00
      3. Level 2: Rate = 10°C/min to 270°C, Final Time = 2.00
      4. Run Time: 40.00 min
      5. Oven Equilibration Time: 1.00 min
   C. Miscellaneous
      1. Peak Width: 0.02
      2. Attentuation: 2^5
      3. Chart Speed: 0.50
      4. Threshold = 0
      5. Offset = 10%

II. MAXIMA PEAK ITEGRATION
   A. Peak Detection Parameters
      1. Baseline Points: 18
      2. Filter Window (in points): 13
      3. Intg. Sensitivity (coarse): 5.00 μV/sec
      4. Intg. Sensitivity (fine): 5.00 μV/sec
   B. Peak Rejection Criteria
      1. Minimum Area: 2000 μV-sec
      2. Minimum Height: 300.0 μV
      3. Minimum Width: 3.00 sec
   C. Integration Events
      1. 0.00: Disable Peak Skimming
      2. 0.00: Disable Peak Detection
      3. 5.00: Enable Peak Detection
      4. 19.96: Set Baseline
      5. 21.74: Set Baseline
      6. 23.23: Set Baseline
      7. 26.20: Set Baseline
      8. 27.58: Set Baseline
      9. 28.66: Set Baseline
      10. 30.20: Set Baseline
      11. 32.81: Set Baseline

IV. MAXIMA DATA ACQUISITION
   A. Preacquisition Delay: 5.00 min
   B. Duration: 35.00 min
   C. Rate: 3.00 points/sec
   D. Run Time: 40.00 min

V. MAXIMA CALIBRATION CURVES
   A. JP-4
      1. Calibration Range = 50 - 50,000 ng/μl
      2. Summation of all peaks detected from 5.00 - 40.00 minutes

FAX

MONTGOMERY WATSON

4525 So. Wasatch Blvd. Suite 200
Salt Lake City, UT 84124-4799
Tel: 801 272-1900
Fax: 801 272-0430

Date: July 29, 1994

To: Todd Wiedemeir

Fax No:

From: Bob Glascott

Reference:

Subject: Survey Data

No. of Pages: (including cover) 3

Todd, here is the survey data, please check the attached map to see that everything is labeled properly, I had problems reading your original fax with the designations. If anything was missed etc. please call and we'll get it fixed. When you finish with the appendicies for the Intrinsic Remediation manual I'd like to get a copy, keep me posted, thanks. B

If you do not receive all pages, or if there are any problems with this transmission, please call Bob Glascott at 801 273-2471

PATRIOT HILLS/HAFB WELLS AND BORINGS
JMM WATSON
27 JULY 1994

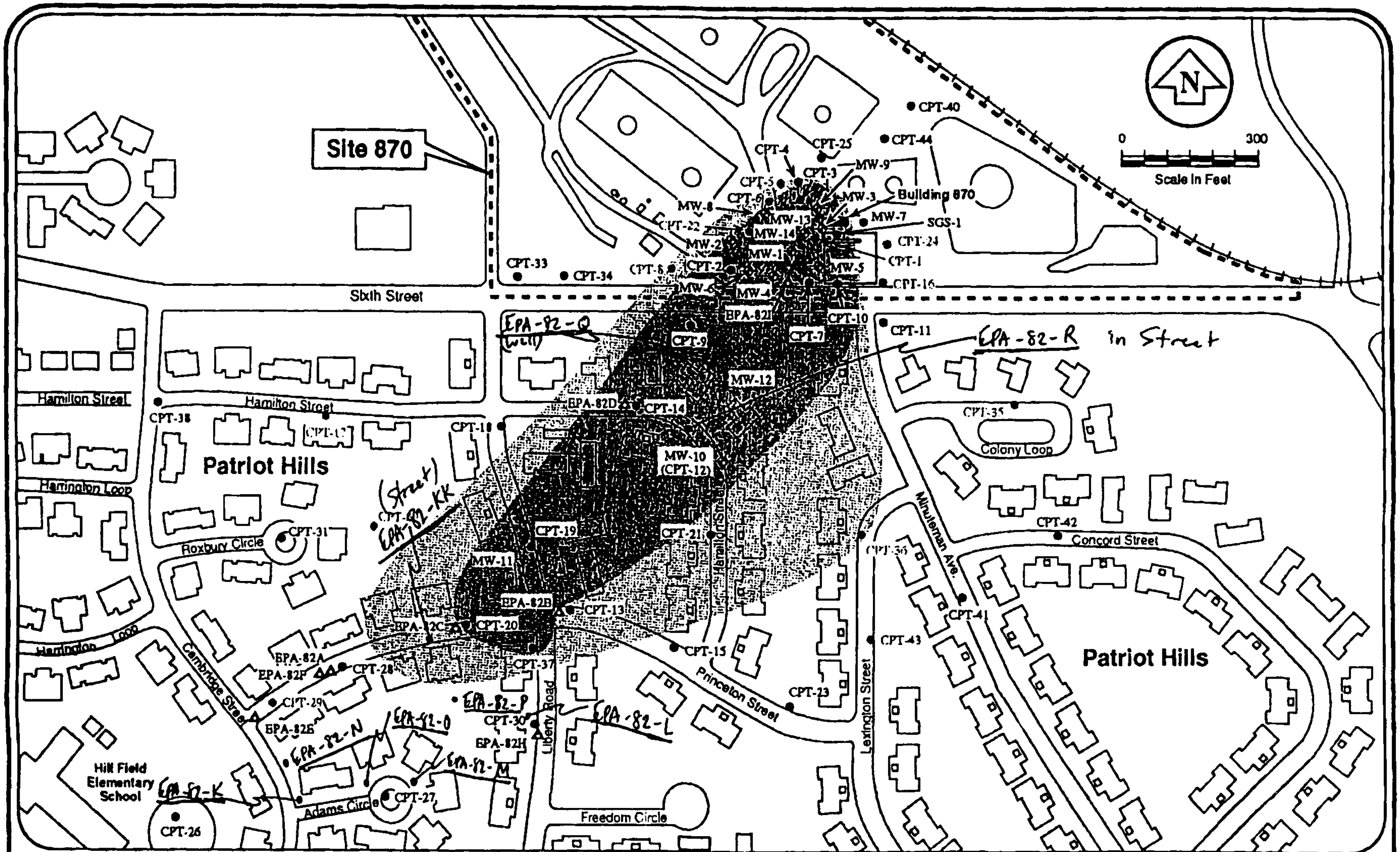
Well No.	Northing	Easting	Elevation	Note
EPA-82L	282834.32	1851944.25	4614.15	Boring
EPA-82M	282698.09	1861700.50	4605.01	Boring
EPA-820	282688.82	1861594.50	4602.30	Boring
EPA-82K	282656.22	1861458.62	4598.38	Boring
EPA-82N	282738.09	1861425.23	4599.81	Boring
EPA-82KK	282995.57	1861711.36	4614.97	Boring
EPA-82P	282865.35	1861776.37	4612.65	Boring
EPA 82-R	283471.51	1862263.77	4660.14	Boring
EPA 82-~~Q~~ J	283645.85	1862398.75	4676.17	Outcase
EPA 82-~~Q~~ J	283645.85	1862398.75	4675.82	PVC

Total Depth = Base of Sampling Interval

ID = 0.25

Screen length = Sample Interval

PROJECT NO. 2208.0683



EXPLANATION

CPT-28 ● Cone penetrometer test point (CPT)/piezometer

MW-12 Monitoring well location

EPA-82H △ EPA research well location

CPT-19 Abandoned CPT location

Railroad

Extent of LNAPL

Extent of contaminated ground water

HILL AIR FORCE BASE

SITE 870

SITE MAP

FIG

JOHN.CRD

Wiedemeier, Todd
~~Engineering Science, Inc.~~
1700 Broadway, Suite 900
Denver, CO 80290
303/831-8100
FAX: 303-831-8208
Home phone: 303/969-0159

From John Wilson
USEPA, Ada. OK.
please ~~[illegible]~~ forward to

pil lens

I - J - D - C - P - M
E - NE8 - M - H

Printed 25-Jul-94 SF-0-70

7/94

DP-P&T/GC-FID:PID Analyses for Dr. Kampbell & Dr. Wilson

SAMPLE NAME	BENZENE	TOLUENE	ETHYLBENZENE	p-XYLENE	m-XYLENE	o-XYLENE	1,3,5-TMB	1,2,4-TMB
QC, OBSERVED, PPB	5.04E+01	4.84E+01	5.22E+01	4.82E+01	4.93E+01	4.99E+01	4.87E+01	4.77E+01
QC, TRUE VALUE, PPB	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01
500 PPB	5.01E+02	5.28E+02	5.25E+02	5.28E+02	5.17E+02	5.18E+02	5.45E+02	5.38E+02
82-A	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
82-B	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
82-C	7.28E+00	9.74E+00	2.27E+01	2.59E+01	1.83E+01	3.18E+00	1.44E+02	1.43E+02
82-D	4.56E+02	9.71E+00	4.54E+02	2.72E+02	4.42E+02	5.07E+01	1.25E+02	1.76E+02
82-E	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
82-F	ND	ND	BLQ	BLQ	BLQ	ND	ND	BLQ
82-F Duplicate	ND	ND	ND	BLQ	BLQ	ND	ND	BLQ
82-H	BLQ	BLQ	BLQ	BLQ	BLQ	ND	ND	BLQ
82-I	5.60E+03	5.87E+03	9.55E+02	1.62E+03	5.13E+03	2.30E+03	4.17E+02	1.27E+03
82-J	4.26E+03	3.91E+03	8.16E+02	1.37E+03	4.22E+03	1.76E+03	4.85E+02	1.31E+03
82-K	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	ND	BLQ
10 PPB	1.01E+01	9.77E+00	9.24E+00	9.24E+00	1.00E+01	9.96E+00	9.58E+00	9.35E+00
82-L1	6.00E+00	1.81E+01	1.03E+02	3.79E+02	5.72E+02	6.04E+02	3.96E+02	4.33E+02
82-L2	4.01E+00	1.88E+01	9.72E+00	2.38E+01	4.92E+01	3.58E+01	2.20E+01	2.86E+01
82-L3	1.44E+00	7.19E+00	4.00E+00	8.53E+00	2.02E+01	1.29E+01	7.43E+00	1.38E+01
82-M	BLQ	3.00E+00	1.58E+00	2.89E+00	7.59E+00	4.95E+00	2.33E+00	4.56E+00
82-M Duplicate	BLQ	3.10E+00	1.50E+00	2.77E+00	7.63E+00	5.10E+00	2.23E+00	4.33E+00
82-N	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	ND	BLQ
82-O	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	ND	BLQ
82-P	BLQ	BLQ	3.50E+00	1.15E+01	1.68E+01	5.99E+00	7.77E+01	1.59E+02
MW-10	2.00E+01	5.47E+01	1.82E+02	1.90E+02	8.47E+02	4.41E+02	2.15E+02	3.03E+02
MW-11	ND	ND	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
MW-12	BLQ	BLQ	9.00E-01	7.62E+00	9.45E+00	1.73E+01	9.89E+00	3.82E+01
100 PPB	9.90E+01	9.78E+01	1.01E+02	1.01E+02	9.82E+01	1.01E+02	1.03E+02	1.01E+02
QC, OBSERVED, PPB	4.83E+01	4.67E+01	5.10E+01	4.80E+01	4.95E+01	4.98E+01	4.72E+01	4.79E+01
QC, TRUE VALUE, PPB	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01
1000 PPB	1.01E+03	1.01E+03	1.02E+03	1.02E+03	1.03E+03	1.01E+03	1.03E+03	1.06E+03

ND = None Detected; BLQ = Below Limit of Quantitation, 1 ppb; N/A = Not Analyzed

Printed 25-Jul-94 SF-0-70

Units = ng/mL Analyst: L. Black

SAMPLE NAME	1,2,4-TMB	1,2,3-TMB	Total Fuel Carbon
QC, OBSERVED, PPB	4.77E+01	4.79E+01	N/A
QC, TRUE VALUE, PPB	5.00E+01	5.00E+01	N/A
500 PPB	5.36E+02	5.42E+02	N/A
82-A	BLQ	BLQ	BLQ
82-B	BLQ	BLQ	BLQ
82-C	1.43E+02	4.29E+01	1.32E+03
82-D	1.76E+02	6.04E+01	3.13E+03
82-E	BLQ	BLQ	BLQ
82-F	BLQ	ND	BLQ
82-F Duplicate	BLQ	ND	BLQ
82-H	BLQ	ND	BLQ
82-I	1.27E+03	4.36E+02	2.68E+04
82-J	1.31E+03	5.15E+02	1.94E+04
82-K	BLQ	ND	BLQ
10 PPB	9.35E+00	9.98E+00	N/A
82-L1	4.33E+02	2.23E+02	3.72E+03
82-L2	2.86E+01	1.52E+01	4.31E+02
82-L3	1.38E+01	6.68E+00	9.62E+01
82-M	4.56E+00	3.06E+00	2.98E+01
82-M Duplicate	4.33E+00	2.93E+00	2.82E+01
82-N	BLQ	BLQ	BLQ
82-O	BLQ	BLQ	BLQ
82-P	1.59E+02	5.79E+01	5.39E+02
MW-10	3.03E+02	1.97E+02	3.67E+03
MW-11	BLQ	BLQ	BLQ
MW-12	3.62E+01	1.33E+01	5.96E+02
100 PPB	1.01E+02	9.86E+01	N/A
QC, OBSERVED, PPB	4.79E+01	4.56E+01	N/A
QC, TRUE VALUE, PPB	5.00E+01	5.00E+01	N/A
1000 PPB	1.06E+03	1.07E+03	N/A

ND = None Detected; BLQ = Below Li

B	1,2,4-TMB
01	4.77E+01
01	5.00E+01
02	5.36E+02
	BLQ
	BLQ
02	1.43E+02
02	1.76E+02
	BLQ
	BLQ
	BLQ
	BLQ
02	1.27E+03
02	1.31E+03
	BLQ
00	9.35E+00
02	4.33E+02
01	2.86E+01
00	1.38E+01
00	4.56E+00
00	4.33E+00
	BLQ
	BLQ
01	1.59E+02
02	3.03E+02
	BLQ
00	3.62E+01
02	1.01E+02
01	4.79E+01
01	5.00E+01
03	1.06E+03

Printed 25-Jul-94 SF-0-70

Units = ng/mL Analyst: L. Black

SAMPLE NAME	1,2,4-TMB	1,2,3-TMB	Total Fuel Carbon
QC, OBSERVED, PPB	4.77E+01	4.79E+01	N/A
QC, TRUE VALUE, PPB	5.00E+01	5.00E+01	N/A
500 PPB	5.36E+02	5.42E+02	N/A
82-A	BLQ	BLQ	BLQ
82-B	BLQ	BLQ	BLQ
82-C	1.43E+02	4.29E+01	1.32E+03
82-D	1.76E+02	6.04E+01	3.13E+03
82-E	BLQ	BLQ	BLQ
82-F	BLQ	ND	BLQ
82-F Duplicate	BLQ	ND	BLQ
82-H	BLQ	ND	BLQ
82-I	1.27E+03	4.36E+02	2.66E+04
82-J	1.31E+03	5.15E+02	1.94E+04
82-K	BLQ	ND	BLQ
10 PPB	9.35E+00	9.98E+00	N/A
82-L1	4.33E+02	2.23E+02	3.72E+03
82-L2	2.86E+01	1.52E+01	4.31E+02
82-L3	1.38E+01	6.86E+00	9.62E+01
82-M	4.56E+00	3.06E+00	2.98E+01
82-M Duplicate	4.33E+00	2.93E+00	2.82E+01
82-N	BLQ	BLQ	BLQ
82-O	BLQ	BLQ	BLQ
82-P	1.59E+02	5.79E+01	5.39E+02
MW-10	3.03E+02	1.97E+02	3.67E+03
MW-11	BLQ	BLQ	BLQ
MW-12	3.62E+01	1.33E+01	5.96E+02
100 PPB	1.01E+02	9.86E+01	N/A
QC, OBSERVED, PPB	4.79E+01	4.56E+01	N/A
QC, TRUE VALUE, PPB	5.00E+01	5.00E+01	N/A
1000 PPB	1.06E+03	1.07E+03	N/A

ND = None Detected; BLQ = Below L

Hill Air Force Base UT

Field Data

Sample	Total Alk mg/l CaCO3	Ferrious Iorn mg/l	Hydrogen Sulfide mg/l
82H	492	<.05	—
82A	530	<.05	<.1
82F	490	.5	<.1
82E	357	<.05	—
82B	428	.1	—
82D	657	7.4	.1
MW10	502	.8	.5
82I	491	10.3	<.1
MW11	504	<.05	—
MW12	450	<.05	—
82L1	730	2.4	<.1
82L2	732	.1	<.1
82L-3	706	.1	—
82M	666	<.05	—
82N	256	<.05	—
82O	566	<.05	—
82K	498	<.05	—
82P	792	.2	—
82J	430	1.3	—

Hill Air Force Base Ut.

Field Data

Sample	Date	Time	Water Level Ft Toc	DO	well Temp	pH	Redox	COND
82H	7-7-94	8:40A	13.34'	5.9	14.7	7.2	272	1384
82A	7-7-94	9:30A	5.12'	<.5	16.3	7.2	240	1622
82F	7-7-94	10:00A	6.48'	<.5	21.5	7.3	-70	1172
82E	7-7-94	10:40A	4.84'	3.7	22.6	7.1	106	2020
82B	7-7-94	1:30p	25.94'	<.5	19.1	7.2	125	1406
82D	7-7-94	2:30p	25.22'	<.5	17.0	7.3	-138	1905
mw10	7-7-94	4:20p	29.48'	<.5	16.6	7.3	-190	1076
82I	7-8-94	8:45A	—	.7	16.3	7.1	-90	1124
mw11	7-8-94	10:00A	26.92'	<.5	15.8	7.0	+140	1125
mw12	7-8-94	11:00A	24.00'	<.5	15.3	7.1	+171	959
82L-1	7-9-94	10:45	—	<.5	17.2	7.1	-106	1662
82L-2	7-9-94	11:25	—	<.5	17.6	7.1	-30	1584
82L-3	7-9-94	1:45P	—	<.5	18.6	7.3	-10	1530
82M	7-9-94	-	—	1.2	18.8	7.3	208	1450
82N	7-11-94	11:00A	—	2.0	20.6	7.4	250	1278
82O	7-11-94	2:30p	—	.5	17.7	7.4	120	1403
82K	7-11-94	4:00p	-	2.0	20.9	7.8	197	1171
82P	7-11-94	5:00p		<.5	—	7.4	—	1671
82J	7-12-94	4:00p	28.4'	2.2	14.7	7.0	—	1280

Sample	mg/l $NO_2^- + NO_3^-$(N)	mg/l Cl^-	mg/l SO_4^{-2}	Conductivity
82L1	<.05	112	<.5	1730
82L1 Dup	<.05	----	----	1731
82L2	.05	86.4	36.0	1645
82L3	.30	90.1	61.0	1588
82M	1.80	73.8	35.4	1509
82N	1.14	120	42.6	1336
82N Dup	----	120	44.8	----
Blank	<.05	<.5	<.5	----
AQC	11.0	40.6	91.3	----
AQC T.V.	11.0	41.2	92.0	----
Spike Rec.	102%	102%	98%	----

Sample	mg/l $NO_2^- + NO_3^-$(N)	mg/l Cl^-	mg/l SO_4^{-2}	Conductivity
82J	.05	158	<.5	1328
82J Dup	.05	----	----	1328
82K	4.44	60.0	59.8	1220
82O	1.63	78.4	37.1	1455
82P	<.05	148	<.5	1704
Blank	<.05	<.5	<.5	----
AQC	11.0	40.6	91.3	----
AQC T.V.	11.0	41.2	92.0	----
Spike Rec.	102%	102%	98%	----

Samples Received July 11, 1994

Sample	mg/L TOC
82 A	2.8
82 B	2.2
82 D	10.3
82 E	1.7
82 F	4.4
82 H	2.6
82 I	67.1
MW-10	9.3
MW-11	3.5
MW-12	2.4
MW-12 Lab Dup	2.4
WP031 II	80.0
RO H_2O	<0.1

Samples Received July 12, 1994

Sample	mg/L TOC
82 L1	5.6
82 L1 Field Dup	4.4
82 L2	3.1
82 L3	2.4
82 M	2.9
82 N	3.7
WP031 II	79.9
RO H_2O	<0.1

Samples Received July 14, 1994

Sample	mg/L TOC
82 J	46.0
82 K	2.4
82 O	2.8
82 P	6.8
82 P Lab Dup	6.8
WP031 II	79.9
RO H_2O	<0.1

True Value of WP031 II = 82.0

Sample	mg/l $NO_2^- + NO_3^-(N)$	mg/l Cl^-	mg/l $SO_4^=$	Cond.
82A	<.05	156	58.6	1,677
82A Dup				1,677
82B	.15	145	74.2	1,450
82D	<.05	221	<.5	1,953
82E	4.39	354	37.0	2,050
82F	1.67	46.9	52.3	1,208
82F Dup		46.1	52.5	
82H	1.51	129	62.3	1,431
82I	<.05	76.7	<.5	1,139
MW10	2.67	47.1	19.5	1,123
MW10 Dup				1,123
MW11	<.05	27.0	99.1	1,161
MW11 Dup	<.05	26.8	102	
MW12	7.73	13.2	29.2	999
Blanks	<.05	<.05	<.05	-----
AQCWP031	.49	40.6	91.9	-----
True Value	.52	41.2	92.0	-----
Spike Recovery	104%	96%	93%	-----

SF-0-70 DATA

LYZED 7/13/94

SAMPLE	METHANE	ETHYLENE	ETHANE
LAB BLANK	BLQ	ND	ND
82 A	0.001	ND	ND
82 B	0.001	ND	ND
82 D	0.002	0.001	0.003
82 E	0.001	ND	ND
82 F	0.577	ND	0.007
82 H	0.001	ND	ND
82 I	1.886	0.001	0.004
82 I LAB DUP	1.755	0.001	0.003
MW-10	0.006	ND	0.001
MW-11	0.005	ND	0.001
MW-12	0.005	ND	0.000

ANALYZED 7/14/94

SAMPLE	METHANE	ETHYLENE	ETHANE
LAB BLANK	BLQ	ND	ND
82 L1	0.018	ND	0.001
[illegible]1 FIELD DUP	0.018	ND	0.001
82 L2	0.003	ND	0.001
82 L3	0.002	ND	0.001
82 M	0.121	ND	0.001
82 N	0.004	ND	0.001

ANALYZED 7/15/94

SAMPLE	METHANE	ETHYLENE	ETHANE
LAB BLANK	BLQ	ND	ND
82 J	0.052	0.009	0.009
82 K	0.003	ND	0.001
82 O	0.001	ND	0.001
82 P	0.004	ND	0.001

STANDARDS	METHANE	ETHYLENE	ETHANE
10 PPM CH4	10.00	ND	ND
100 PPM CH4	100.00	ND	ND
1060 PPM CH4	995.11	ND	ND
1 % CH4	1.01	ND	ND
4 % CH4	4.00	ND	ND
[illegible]0 PPM C2H4	ND	10.01	ND
[illegible] PPM C2H4	ND	100.00	ND

Analytical Report

Mountain States Analytical
The Quality Solution

CLIENT:	Montgomery 4525 So. Wasatch #200 Salt Lake City, UT 84124	LAB NO:	22313
		GROUP NO:	4674
		DATE SAMPLED:	11/06/91
		TIME SAMPLED:	1350
		DATE RECEIVED:	11/07/91
ATTN:	Mr. Dave Fulton	DATE REPORTED:	11/14/91
		DISPOSAL DATE:	12/14/91

SAMPLE ID: SB870A-01/16'-17'

ANALYSIS: Total Petroleum Hydrocarbons by EPA SW-846 Methods 3550/8015 Modified [Utah]. Benzene, Toluene, Ethylbenzene, Xylenes by EPA SW-846 Methods 5030/8020.

COMPOUNDS	RESULT DRY WEIGHT	LIMIT OF QUANTITATION
Moisture	21.9 %	
Benzene	150 ug/kg	10.0 ug/kg
Toluene	129 ug/kg	10.0 ug/kg
Ethylbenzene	57.0 ug/kg	10.0 ug/kg
m,p-Xylene	203 ug/kg	10.0 ug/kg
o-Xylene	115 ug/kg	10.0 ug/kg
TPH	< 10.0 mg/kg	10.0 mg/kg

Date Analyzed (TPH): 11/12/91
Date Analyzed (BTEX): 11/14/91

Note:

Diesel fuel calibration standards were used for TPH quantitation.

Respectfully submitted,

Matt Sorensen For

Kenneth A. Roberts, B.S.
Manager, Organics Department

1645 West 2200 South, Salt Lake City, Utah 84119 (801) 973-0050 FAX (801) 972-6278

Analytical Report

Mountain States Analytical

The Quality Solution

CLIENT: Montgomery
4525 So. Wasatch #200
Salt Lake City, UT 84124-
Phone: 801-272-1900 801-272-0430 (FAX)
ATTN: Mr. David Fulton
Project: HAFB

Date Samples Rec'd: 11/07/91
MSAI Group No.: 4674
Sample Matrix: Non-Aqueous/Solid
Report Date: 11/14/91
P.O. Number: 2208.0312

LAB NO.	SAMPLE DATE	SAMP TIME	SAMPLE DESCRIPTION	ANALYSES PERFORMED	RESULT
22313	11/06/91	1350	SB870A-01/16'-17'	BTEX/TPH 8015/8020(D)	See Attach ---
				Homogenization-Vol. GC	Complete ---
				Moisture	21.9 %
22314	11/06/91	1400	SB870A-01/18'-19'	BTEX/TPH 8015/8020(D)	See Attach ---
				Homogenization-Vol. GC	Complete ---
				Moisture	19.4 %

NOV 20 1991

Respectfully submitted,

Douglas W. Later

Douglas W. Later, Ph.D.
Laboratory Director

Glenn A. Sorensen

Glenn A. Sorensen, B.S.
Manager, Technical Operations

Mountain States Analytical

The Quality Solution

CLIENT:	Montgomery 4525 So. Wasatch #200 Salt Lake City, UT 84124	LAB NO:	22314
		GROUP NO:	4674
		DATE SAMPLED:	11/06/91
		TIME SAMPLED:	1400
		DATE RECEIVED:	11/07/91
ATTN:	Mr. Dave Fulton	DATE REPORTED:	11/14/91
		DISPOSAL DATE:	12/14/91

SAMPLE ID: SB870A-01/18'-19'

ANALYSIS: Total Petroleum Hydrocarbons by EPA SW-846 Methods 3550/8015 Modified [Utah]. Benzene, Toluene, Ethylbenzene, Xylenes by EPA SW-846 Methods 5030/8020.

COMPOUNDS	RESULT DRY WEIGHT	LIMIT OF QUANTITATION
Moisture	19.4 %	
Benzene	564 ug/kg	20.0 ug/kg
Toluene	145 ug/kg	20.0 ug/kg
Ethylbenzene	341 ug/kg	20.0 ug/kg
m,p-Xylene	1,640 ug/kg	20.0 ug/kg
o-Xylene	609 ug/kg	20.0 ug/kg
TPH	98.3 mg/kg	10.0 mg/kg

Date Analyzed (TPH): 11/12/91
Date Analyzed (BTEX): 11/14/91

Note:

Diesel fuel calibration standards were used for TPH quantitation.

Respectfully submitted,

Matt Sorensen for

Kenneth A. Roberts, B.S.
Manager, Organics Department

1645 West 2200 South, Salt Lake City, Utah 84119 (801) 973-0050 FAX (801) 972-6278

MONTGOMERY LABORATORIES

CHAIN OF CUSTODY RECORD

PROJECT/JOB # 2208.0312

PROJECT NAME Hafs

SAMPLERS: (Signature) [signature]

STA. NO.	DATE	TIME	COMP	GRAB	STATION LOCATION	NO. OF CONTAINERS	ANALYSIS (USE 1 COLUMN PER BOTTLE): TPH w/ BTEX & diesel	ANALYSIS: w/ 8015/8020								REMARKS
	11/6/91	1350		✓	SB870A-01 / 16'-17'	1	✓									
	11/6/91	1400		✓	SB870A-01 / 18'-19'	1	✓									

RELINQUISHED BY: (SIGNATURE)	DATE / TIME	RECEIVED BY: (SIGNATURE)	RELINQUISHED BY: (SIGNATURE)	DATE / TIME	RECEIVED BY: (SIGNATURE)
[signature]	11/6/91 / 1722	Douglas W. Roth			
RELINQUISHED BY: (SIGNATURE)	DATE / TIME	RECEIVED BY: (SIGNATURE)	RELINQUISHED BY: (SIGNATURE)	DATE / TIME	RECEIVED BY: (SIGNATURE)
RELINQUISHED BY: (SIGNATURE)	DATE / TIME	RECEIVED FOR LABORATORY BY: (SIGNATURE)	DATE / TIME	REMARKS	

Analytical Report

Mountain States Analytical

The Quality Solution

CLIENT: J.M. Montgomery Engineers
4525 So. Wasatch #200
Salt Lake City, UT 84124

ATTN: Mr. David Fulton

LAB NO: 22369
GROUP NO: 4687
DATE SAMPLED: 11/07/91
TIME SAMPLED: 1111
DATE RECEIVED: 11/08/91
DATE REPORTED: 11/21/91
DISPOSAL DATE: 12/21/91

SAMPLE ID: SB870A 02/15'16'

ANALYSIS: Total Petroleum Hydrocarbons by EPA SW-846 Methods 3550/8015 Modified [Utah]. Benzene, Toluene, Ethylbenzene, Xylenes by EPA SW-846 Methods 5030/8020.

COMPOUNDS	RESULT DRY WEIGHT	LIMIT OF QUANTITATION
Moisture	18.9 %	
Benzene	43.2 ug/kg	10.0 ug/kg
Toluene	51.3 ug/kg	10.0 ug/kg
Ethylbenzene	52.2 ug/kg	10.0 ug/kg
m,p-Xylene	365 ug/kg	10.0 ug/kg
o-Xylene	92.3 ug/kg	10.0 ug/kg
TPH	23.2 mg/kg	10.0 mg/kg

Date Analyzed (TPH): 11/13/91
Date Analyzed (BTEX): 11/20/91

Note:

Diesel fuel calibration standards were used for TPH quantitation.

Respectfully submitted,

Kenneth A. Roberts

Kenneth A. Roberts, B.S.
Manager, Organics Department

Analytical Report

Mountain States Analytical
The Quality Solution

CLIENT:	J.M. Montgomery Engineers 4525 So. Wasatch #200 Salt Lake City, UT 84124	Date Samples Rec'd:	11/08/91
		MSAI Group No.:	4687
		Sample Matrix:	Non-Aqueous/Solid
Phone:	801-272-1900 801-272-0430 (FAX)	Report Date:	11/21/91
ATTN:	Mr. David Fulton	P.O. Number:	2208.0312
Project:	HAFB		

LAB NO.	SAMPLE DATE	SAMP TIME	SAMPLE DESCRIPTION	ANALYSES PERFORMED	RESULT
22369	11/07/91	1111	SB870A 02/15'-16'	BTEX/TPH 8015/8020(D)	See Attach ---
				Homogenization-Vol. GC	Complete ---
				Moisture	18.9 %
22370	11/07/91	1122	SB870A 02/17'-18'	BTEX/TPH 8015/8020(D)	See Attach ---
				Homogenization-Vol. GC	Complete ---
				Moisture	24.2 %
22371	11/07/91	1427	SB870A 03/11'-12'	BTEX/TPH 8015/8020(D)	See Attach ---
				Homogenization-Vol. GC	Complete ---
				Moisture	7.26 %
22372	11/07/91	1530	SB870A 03/19'-20'	BTEX/TPH 8015/8020(D)	See Attach ---
				Homogenization-Vol. GC	Complete ---
				Carbon, Organic TOC sw	1,100 mg/kg
				Moisture	20.3 %
22373	11/07/91	1630	SB870A 03/29'-30'	BTEX/TPH 8015/8020(D)	See Attach ---
				Homogenization-Vol. GC	Complete ---
				Moisture	14.0 %

Respectfully submitted,

Douglas W. Later

Douglas W. Later, Ph.D.
Laboratory Director

Glenn A. Sorensen

Glenn A. Sorensen, B.S.
Manager, Technical Operations

Analytical Report

Mountain States Analytical

The Quality Solution

CLIENT: J.M. Montgomery Engineers
4525 So. Wasatch #200
Salt Lake City, UT 84124

ATTN: Mr. David Fulton

LAB NO: 22370
GROUP NO: 4687
DATE SAMPLED: 11/07/91
TIME SAMPLED: 1122
DATE RECEIVED: 11/08/91
DATE REPORTED: 11/21/91
DISPOSAL DATE: 12/21/91

SAMPLE ID: SB870A 02/17'18'

ANALYSIS: Total Petroleum Hydrocarbons by EPA SW-846 Methods 3550/8015 Modified [Utah]. Benzene, Toluene, Ethylbenzene, Xylenes by EPA SW-846 Methods 5030/8020.

COMPOUNDS	RESULT DRY WEIGHT	LIMIT OF QUANTITATION
Moisture	24.2 %	
Benzene	13.0 ug/kg	10.0 ug/kg
Toluene	60.2 ug/kg	10.0 ug/kg
Ethylbenzene	57.7 ug/kg	10.0 ug/kg
m,p-Xylene	386 ug/kg	10.0 ug/kg
o-Xylene	123 ug/kg	10.0 ug/kg
TPH	37.0 mg/kg	10.0 mg/kg

Date Analyzed (TPH): 11/13/91
Date Analyzed (BTEX): 11/20/91

Note:

Diesel fuel calibration standards were used for TPH quantitation.

Respectfully submitted,

Kenneth A. Roberts

Kenneth A. Roberts, B.S.
Manager, Organics Department

Analytical Report

Mountain States Analytical

The Quality Solution

CLIENT: J.M. Montgomery Engineers
4525 So. Wasatch #200
Salt Lake City, UT 84124

LAB NO: 22371
GROUP NO: 4687
DATE SAMPLED: 11/07/91
TIME SAMPLED: 1427
DATE RECEIVED: 11/08/91
DATE REPORTED: 11/21/91
DISPOSAL DATE: 12/21/91

ATTN: Mr. David Fulton

SAMPLE ID: SB870A 03/11'-12'

ANALYSIS: Total Petroleum Hydrocarbons by EPA SW-846 Methods 3550/8015 Modified [Utah]
Benzene, Toluene, Ethylbenzene, Xylenes by EPA SW-846 Methods 5030/8020

COMPOUNDS	RESULT DRY WEIGHT	LIMIT OF QUANTITATION
Moisture	7.3 %	
Benzene	9,400 ug/kg	5,000 ug/kg
Toluene	115,000 ug/kg	5,000 ug/kg
Ethylbenzene	66,700 ug/kg	5,000 ug/kg
m,p-Xylene	494,000 ug/kg	5,000 ug/kg
o-Xylene	140,000 ug/kg	5,000 ug/kg
TPH	2,790 mg/kg	200 mg/kg

Date Analyzed (TPH): 11/13/91
Date Analyzed (BTEX): 11/20/91

Note:

A. Gasoline calibration standards were used for TPH quantitation.

Respectfully submitted,

Kenneth A. Roberts

Kenneth A. Roberts, B.S.
Manager, Organics Department

1645 West 2200 South, Salt Lake City, Utah 84119 (801) 973-0050 FAX (801) 972-6278

Analytical Report

Mountain States Analytical

The Quality Solution

CLIENT:	J.M. Montgomery Engineers 4525 So. Wasatch #200 Salt Lake City, UT 84124	LAB NO:	22373
		GROUP NO:	4687
		DATE SAMPLED:	11/07/91
		TIME SAMPLED:	1630
		DATE RECEIVED:	11/08/91
ATTN:	Mr. David Fulton	DATE REPORTED:	11/21/91
		DISPOSAL DATE:	12/21/91

SAMPLE ID: SB870A 03/29'-30'

ANALYSIS: Total Petroleum Hydrocarbons by EPA SW-846 Methods 3550/8015 Modified [Utah] Benzene, Toluene, Ethylbenzene, Xylenes by EPA SW-846 Methods 5030/8020

COMPOUNDS	RESULT DRY WEIGHT	LIMIT OF QUANTITATION
Moisture	14.0 %	
Benzene	22,200 ug/kg	5,000 ug/kg
Toluene	187,000 ug/kg	5,000 ug/kg
Ethylbenzene	83,100 ug/kg	5,000 ug/kg
m,p-Xylene	567,000 ug/kg	5,000 ug/kg
o-Xylene	177,000 ug/kg	5,000 ug/kg
TPH	15,100 mg/kg	1,000 mg/kg

Date Analyzed (TPH): 11/13/91
Date Analyzed (BTEX): 11/20/91

Note:

A. Gasoline calibration standards were used for TPH quantitation.

Respectfully submitted,

Kenneth A. Roberts

Kenneth A. Roberts, B.S.
Manager, Organics Department

1645 West 2200 South, Salt Lake City, Utah 84119 (801) 973-0050 FAX (801) 972-6278

Mountain States Analytical
The Quality Solution

CLIENT: J.M. Montgomery Engineers
4525 So. Wasatch #200
Salt Lake City, UT 84124

ATTN: Mr. David Fulton

LAB NO: 22372
GROUP NO: 4687
DATE SAMPLED: 11/07/91
TIME SAMPLED: 1530
DATE RECEIVED: 11/08/91
DATE REPORTED: 11/21/91
DISPOSAL DATE: 12/21/91

SAMPLE ID: SB870A 03/19'-20'

ANALYSIS: Total Petroleum Hydrocarbons by EPA SW-846 Methods 3550/8015 Modified [Utah]. Benzene, Toluene, Ethylbenzene, Xylenes by EPA SW-846 Methods 5030/8020.

COMPOUNDS	RESULT DRY WEIGHT	LIMIT OF QUANTITATION
Moisture	20.3 %	
Benzene	338 ug/kg	10.0 ug/kg
Toluene	595 ug/kg	10.0 ug/kg
Ethylbenzene	138 ug/kg	10.0 ug/kg
m,p-Xylene	867 ug/kg	10.0 ug/kg
o-Xylene	276 ug/kg	10.0 ug/kg
TPH	< 10.0 mg/kg	10.0 mg/kg

Date Analyzed (TPH): 11/13/91
Date Analyzed (BTEX): 11/20/91

Note:
Diesel fuel calibration standards were used for TPH quantitation.

Respectfully submitted,

Kenneth A. Roberts

Kenneth A. Roberts, B.S.
Manager, Organics Department

1645 West 2200 South, Salt Lake City, Utah 84119 (801) 973-0050 FAX (801) 972-6278

Analytical Report

Mountain States Analytical

The Quality Solution

CLIENT:	J.M. Montgomery Engineers 4525 So. Wasatch #200 Salt Lake City, UT 84124-	SAMPLE NO:	0001523
		SAMPLE SET NO:	000297S
		DATE SAMPLED:	11/23/92
		TIME SAMPLED:	1500
ATTN:	Mr. Robert Glascot	DATE RECEIVED:	11/25/92
		DATE REPORTED:	12/10/92
SAMPLE ID:	870-WS-1/32'	DISPOSAL DATE:	01/09/93

ANALYSIS: Volatiles - Water Matrix [EPA 601/602] (Capillary)

COMPOUND(s)		RESULT	LIMIT OF QUANTITATION
Chloromethane	<	2.0 ug/l	2.0 ug/l
Vinyl Chloride	<	2.0 ug/l	2.0 ug/l
Bromomethane	<	2.0 ug/l	2.0 ug/l
Chloroethane	<	2.0 ug/l	2.0 ug/l
Fluorotrichloromethane	<	2.0 ug/l	2.0 ug/l
1,1-Dichloroethene	<	1.0 ug/l	1.0 ug/l
Dichloromethane	<	1.0 ug/l	1.0 ug/l
trans-1,2-Dichloroethene	<	1.0 ug/l	1.0 ug/l
1,1-Dichloroethane	<	1.0 ug/l	1.0 ug/l
Chloroform	<	1.0 ug/l	1.0 ug/l
1,1,1-Trichloroethane	<	1.0 ug/l	1.0 ug/l
Carbon Tetrachloride	<	1.0 ug/l	1.0 ug/l
Benzene		17.4 ug/l	1.0 ug/l
1,2-Dichloroethane	<	1.0 ug/l	1.0 ug/l
Trichloroethene (TCE)	<	1.0 ug/l	1.0 ug/l
1,2-Dichloropropane	<	1.0 ug/l	1.0 ug/l
Bromodichloromethane	<	1.0 ug/l	1.0 ug/l
cis-1,3-Dichloropropene	<	1.0 ug/l	1.0 ug/l
trans-1,3-Dichloropropene	<	1.0 ug/l	1.0 ug/l
Toluene		1.8 ug/l	1.0 ug/l
Tetrachloroethene (PCE)	<	1.0 ug/l	1.0 ug/l
Chlorodibromomethane	<	1.0 ug/l	1.0 ug/l
Chlorobenzene	<	1.0 ug/l	1.0 ug/l
Ethylbenzene	<	1.0 ug/l	1.0 ug/l
Bromoform	<	2.0 ug/l	2.0 ug/l
m,p-Xylene		4.9 ug/l	1.0 ug/l
o-Xylene/Styrene*		1.3 ug/l	1.0 ug/l

-Continued-

o-xylene & styrene coeluted [illegible] o-xylene. [illegible]

1645 West 2200 South, Salt Lake City, Utah 84119 (801) 973-0050 FAX (801) 972-6278

Mountain States Analytical

The Quality Solution

CLIENT:	J.M. Montgomery Engineers 4525 So. Wasatch #200 Salt Lake City, UT 84124-	LAB NO:	0001523
		GROUP NO:	000297S
		DATE SAMPLED:	11/23/92
		TIME SAMPLED:	1500
ATTN:	Mr. Robert Glascot	DATE RECEIVED:	11/25/92
		DATE REPORTED:	12/10/92
SAMPLE ID:	870-WS-1/32'	DISPOSAL DATE:	01/09/93

COMPOUND(s)		FINAL RESULT	LIMIT OF QUANTITATION
1,1,2,2-Tetrachloroethane	<	1.0 ug/l	1.0 ug/l
1,1,2-Trichloroethane	<	1.0 ug/l	1.0 ug/l
1,2-Dichlorobenzene	<	1.0 ug/l	1.0 ug/l
1,3-Dichlorobenzene	<	1.0 ug/l	1.0 ug/l
1,4-Dichlorobenzene	<	1.0 ug/l	1.0 ug/l

Date Analyzed: 12/02/92

*These compounds coelute under the conditions used. The result represents the total amount for these compounds.

Respectfully submitted,

Kenneth A. Roberts

Kenneth A. Roberts, B.S.
GC Group Leader

1645 West 2200 South, Salt Lake City, Utah 84119 (801) 973-0050 FAX (801) 972-6278

Mountain States Analytical

The Quality Solution

CLIENT:	J.M. Montgomery Engineers 4525 So. Wasatch #200 Salt Lake City, UT 84124-	SAMPLE NO:	0001524
		SAMPLE SET NO:	000297S
		DATE SAMPLED:	11/23/92
		TIME SAMPLED:	1630
ATTN:	Mr. Robert Glascot	DATE RECEIVED:	11/25/92
		DATE REPORTED:	12/10/92
SAMPLE ID:	870-WS-1/42'	DISPOSAL DATE:	01/09/93

ANALYSIS: Volatiles - Water Matrix [EPA 601/602] (Capillary)

COMPOUND(s)		RESULT	LIMIT OF QUANTITATION
Chloromethane	<	20.0 ug/l	20.0 ug/l
Vinyl Chloride	<	20.0 ug/l	20.0 ug/l
Bromomethane	<	20.0 ug/l	20.0 ug/l
Chloroethane	<	20.0 ug/l	20.0 ug/l
Fluorotrichloromethane	<	20.0 ug/l	20.0 ug/l
1,1-Dichloroethene	<	10.0 ug/l	10.0 ug/l
Dichloromethane	<	10.0 ug/l	10.0 ug/l
trans-1,2-Dichloroethene	<	10.0 ug/l	10.0 ug/l
1,1-Dichloroethane	<	10.0 ug/l	10.0 ug/l
Chloroform	<	10.0 ug/l	10.0 ug/l
1,1,1-Trichloroethane	<	10.0 ug/l	10.0 ug/l
Carbon Tetrachloride	<	10.0 ug/l	10.0 ug/l
Benzene		30.5 ug/l	10.0 ug/l
1,2-Dichloroethane	<	10.0 ug/l	10.0 ug/l
Trichloroethene (TCE)	<	10.0 ug/l	10.0 ug/l
1,2-Dichloropropane	<	10.0 ug/l	10.0 ug/l
Bromodichloromethane	<	10.0 ug/l	10.0 ug/l
cis-1,3-Dichloropropene	<	10.0 ug/l	10.0 ug/l
trans-1,3-Dichloropropene	<	10.0 ug/l	10.0 ug/l
Toluene		113 ug/l	10.0 ug/l
Tetrachloroethene (PCE)	<	10.0 ug/l	10.0 ug/l
Chlorodibromomethane	<	10.0 ug/l	10.0 ug/l
Chlorobenzene	<	10.0 ug/l	10.0 ug/l
Ethylbenzene		56.4 ug/l	10.0 ug/l
Bromoform	<	20.0 ug/l	20.0 ug/l
m,p-Xylene		369 ug/l	10.0 ug/l
o-Xylene/Styrene*		103 ug/l	10.0 ug/l

-Continued-

Mountain States Analytical

The Quality Solution

CLIENT:	J.M. Montgomery Engineers 4525 So. Wasatch #200 Salt Lake City, UT 84124-	LAB NO:	0001524
		GROUP NO:	000297S
		DATE SAMPLED:	11/23/92
		TIME SAMPLED:	1630
ATTN:	Mr. Robert Glascot	DATE RECEIVED:	11/25/92
		DATE REPORTED:	12/10/92
SAMPLE ID:	870-WS-1/42'	DISPOSAL DATE:	01/09/93

COMPOUND(s)	FINAL RESULT	LIMIT OF QUANTITATION
1,1,2,2-Tetrachloroethane	< 10.0 ug/l	10.0 ug/l
1,1,2-Trichloroethane	< 10.0 ug/l	10.0 ug/l
1,2-Dichlorobenzene	< 10.0 ug/l	10.0 ug/l
1,3-Dichlorobenzene	< 10.0 ug/l	10.0 ug/l
1,4-Dichlorobenzene	< 10.0 ug/l	10.0 ug/l

Date Analyzed: 12/09/92

*These compounds coelute under the conditions used. The result represents the total amount for these compounds.

Respectfully submitted,

Kenneth A. Roberts

Kenneth A. Roberts, B.S.
GC Group Leader

1645 West 2200 South, Salt Lake City, Utah 84119 (801) 973-0050 FAX (801) 972-6278

Analytical Report

Mountain States Analytical

The Quality Solution

CLIENT:	J.M. Montgomery Engineers 4525 So. Wasatch #200 Salt Lake City, UT 84124-	SAMPLE NO:	0001533
		SAMPLE SET NO:	000297S
		DATE SAMPLED:	11/24/92
		TIME SAMPLED:	830
ATTN:	Mr. Robert Glascot	DATE RECEIVED:	11/25/92
		DATE REPORTED:	12/10/92
SAMPLE ID:	870-WS-1/52'	DISPOSAL DATE:	01/09/93

ANALYSIS: Volatiles - Water Matrix [EPA 601/602] (Capillary)

COMPOUND(s)		RESULT	LIMIT OF QUANTITATION
Chloromethane	<	2.0 ug/l	2.0 ug/l
Vinyl Chloride	<	2.0 ug/l	2.0 ug/l
Bromomethane	<	2.0 ug/l	2.0 ug/l
Chloroethane	<	2.0 ug/l	2.0 ug/l
Fluorotrichloromethane	<	2.0 ug/l	2.0 ug/l
1,1-Dichloroethene	<	1.0 ug/l	1.0 ug/l
Dichloromethane	<	1.0 ug/l	1.0 ug/l
trans-1,2-Dichloroethene	<	1.0 ug/l	1.0 ug/l
1,1-Dichloroethane	<	1.0 ug/l	1.0 ug/l
Chloroform	<	1.0 ug/l	1.0 ug/l
1,1,1-Trichloroethane	<	1.0 ug/l	1.0 ug/l
Carbon Tetrachloride	<	1.0 ug/l	1.0 ug/l
Benzene		27.0 ug/l	1.0 ug/l
1,2-Dichloroethane	<	1.0 ug/l	1.0 ug/l
Trichloroethene (TCE)	<	1.0 ug/l	1.0 ug/l
1,2-Dichloropropane	<	1.0 ug/l	1.0 ug/l
Bromodichloromethane	<	1.0 ug/l	1.0 ug/l
cis-1,3-Dichloropropene	<	1.0 ug/l	1.0 ug/l
trans-1,3-Dichloropropene	<	1.0 ug/l	1.0 ug/l
Toluene		59.3 ug/l	1.0 ug/l
Tetrachloroethene (PCE)	<	1.0 ug/l	1.0 ug/l
Chlorodibromomethane	<	1.0 ug/l	1.0 ug/l
Chlorobenzene	<	1.0 ug/l	1.0 ug/l
Ethylbenzene		21.6 ug/l	1.0 ug/l
Bromoform	<	2.0 ug/l	2.0 ug/l
m,p-Xylene		107 ug/l	1.0 ug/l
o-Xylene/Styrene*		36.4 ug/l	1.0 ug/l

-Continued-

Mountain States Analytical

The Quality Solution

James M. Montgomery Engineers
4525 South Wasatch Blvd., Suite 200
Salt Lake City, UT 84124
Telephone: (801) 272-1900
Facsimile: (801) 272-0403

Sample Number: 0001533
Sample Set: 000297S
Date Reported: 10 DEC 1992
Date Received: 25 NOV 1992
Disposal Date: 8 JAN 1993

Attention: Robert Glascot
Project: HAFB USTs
Case Number: VOCs/BTEXN
Purchase Order: 2208.0585

Customer Number: 870-WS-1/52'
Date Sampled: 24 NOV 1992
Matrix: Water/Waste Water
Containers: 3

Analysis	Catalog Number	Method	Result	Dry Result	Reporting Units
Volatile Aromatics/Halocarbons	05515	EPA 600 Series 601/ 602	See Attached		

1 Analysis for GC

Reviewed and approved by
Kenneth Roberts, B.S.
GC Group Leader

1 Analysis for Sample Number 0001533

Mountain States Analytical

The Quality Solution

CLIENT:	J.M. Montgomery Engineers 4525 So. Wasatch #200 Salt Lake City, UT 84124-	SAMPLE NO:	0001526
		SAMPLE SET NO:	000297S
		DATE SAMPLED:	11/24/92
		TIME SAMPLED:	1015
ATTN:	Mr. Robert Glascot	DATE RECEIVED:	11/25/92
		DATE REPORTED:	12/10/92
SAMPLE ID:	870-WS 2/49'	DISPOSAL DATE:	01/09/93

ANALYSIS: Volatiles - Water Matrix [EPA 601/602] (Capillary)

COMPOUND(s)		RESULT	LIMIT OF QUANTITATION
Chloromethane	<	2.0 ug/l	2.0 ug/l
Vinyl Chloride	<	2.0 ug/l	2.0 ug/l
Bromomethane	<	2.0 ug/l	2.0 ug/l
Chloroethane	<	2.0 ug/l	2.0 ug/l
Fluorotrichloromethane	<	2.0 ug/l	2.0 ug/l
1,1-Dichloroethene	<	1.0 ug/l	1.0 ug/l
Dichloromethane	<	1.0 ug/l	1.0 ug/l
trans-1,2-Dichloroethene	<	1.0 ug/l	1.0 ug/l
1,1-Dichloroethane	<	1.0 ug/l	1.0 ug/l
Chloroform	<	1.0 ug/l	1.0 ug/l
1,1,1-Trichloroethane	<	1.0 ug/l	1.0 ug/l
Carbon Tetrachloride	<	1.0 ug/l	1.0 ug/l
Benzene		8.4 ug/l	1.0 ug/l
1,2-Dichloroethane	<	1.0 ug/l	1.0 ug/l
Trichloroethene (TCE)	<	1.0 ug/l	1.0 ug/l
1,2-Dichloropropane	<	1.0 ug/l	1.0 ug/l
Bromodichloromethane	<	1.0 ug/l	1.0 ug/l
cis-1,3-Dichloropropene	<	1.0 ug/l	1.0 ug/l
trans-1,3-Dichloropropene	<	1.0 ug/l	1.0 ug/l
Toluene		13.8 ug/l	1.0 ug/l
Tetrachloroethene (PCE)	<	1.0 ug/l	1.0 ug/l
Chlorodibromomethane	<	1.0 ug/l	1.0 ug/l
Chlorobenzene	<	1.0 ug/l	1.0 ug/l
Ethylbenzene		4.5 ug/l	1.0 ug/l
Bromoform	<	2.0 ug/l	2.0 ug/l
m,p-Xylene		30.2 ug/l	1.0 ug/l
o-Xylene/Styrene*		9.4 ug/l	1.0 ug/l

-Continued-

Analytical Report

Mountain States Analytical

The Quality Solution

CLIENT:	J.M. Montgomery Engineers 4525 So. Wasatch #200 Salt Lake City, UT 84124-	LAB NO:	0001526
		GROUP NO:	000297S
		DATE SAMPLED:	11/24/92
		TIME SAMPLED:	1015
ATTN:	Mr. Robert Glascot	DATE RECEIVED:	11/25/92
		DATE REPORTED:	12/10/92
SAMPLE ID:	870-WS 2/49'	DISPOSAL DATE:	01/09/93

COMPOUND(s)		FINAL RESULT	LIMIT OF QUANTITATION
1,1,2,2-Tetrachloroethane	<	1.0 ug/l	1.0 ug/l
1,1,2-Trichloroethane	<	1.0 ug/l	1.0 ug/l
1,2-Dichlorobenzene	<	1.0 ug/l	1.0 ug/l
1,3-Dichlorobenzene	<	1.0 ug/l	1.0 ug/l
1,4-Dichlorobenzene	<	1.0 ug/l	1.0 ug/l

Date Analyzed: 12/02/92

*These compounds coelute under the conditions used. The result represents the total amount for these compounds.

Respectfully submitted,

Kenneth A Roberts

Kenneth A. Roberts, B.S.
GC Group Leader

1645 West 2200 South, Salt Lake City, Utah 84119 (801) 973-0050 FAX (801) 972-6278

Mountain States Analytical
The Quality Solution

CLIENT: J.M. Montgomery Engineers
4525 So. Wasatch #200
Salt Lake City, UT 84124-

ATTN: Mr. Robert Glascot

SAMPLE ID: 870-WS-2/59'

SAMPLE NO: 0001528
SAMPLE SET NO: 000297S
DATE SAMPLED: 11/24/92
TIME SAMPLED: 1200
DATE RECEIVED: 11/25/92
DATE REPORTED: 12/10/92
DISPOSAL DATE: 01/09/93

ANALYSIS: Volatiles - Water Matrix [EPA 601/602] (Capillary)

COMPOUND(s)		RESULT	LIMIT OF QUANTITATION
Chloromethane	<	2.0 ug/l	2.0 ug/l
Vinyl Chloride	<	2.0 ug/l	2.0 ug/l
Bromomethane	<	2.0 ug/l	2.0 ug/l
Chloroethane	<	2.0 ug/l	2.0 ug/l
Fluorotrichloromethane	<	2.0 ug/l	2.0 ug/l
1,1-Dichloroethene	<	1.0 ug/l	1.0 ug/l
Dichloromethane	<	1.0 ug/l	1.0 ug/l
trans-1,2-Dichloroethene	<	1.0 ug/l	1.0 ug/l
1,1-Dichloroethane	<	1.0 ug/l	1.0 ug/l
Chloroform	<	1.0 ug/l	1.0 ug/l
1,1,1-Trichloroethane	<	1.0 ug/l	1.0 ug/l
Carbon Tetrachloride	<	1.0 ug/l	1.0 ug/l
Benzene		24.0 ug/l	1.0 ug/l
1,2-Dichloroethane	<	1.0 ug/l	1.0 ug/l
Trichloroethene (TCE)	<	1.0 ug/l	1.0 ug/l
1,2-Dichloropropane	<	1.0 ug/l	1.0 ug/l
Bromodichloromethane	<	1.0 ug/l	1.0 ug/l
cis-1,3-Dichloropropene	<	1.0 ug/l	1.0 ug/l
trans-1,3-Dichloropropene	<	1.0 ug/l	1.0 ug/l
Toluene		68.0 ug/l	1.0 ug/l
Tetrachloroethene (PCE)	<	1.0 ug/l	1.0 ug/l
Chlorodibromomethane	<	1.0 ug/l	1.0 ug/l
Chlorobenzene	<	1.0 ug/l	1.0 ug/l
Ethylbenzene		50.7 ug/l	1.0 ug/l
Bromoform	<	2.0 ug/l	2.0 ug/l
m,p-Xylene		294 ug/l	50.0 ug/l
o-Xylene/Styrene*		93.7 ug/l	1.0 ug/l

-Continued-

Mountain States Analytical
The Quality Solution

CLIENT:	J.M. Montgomery Engineers 4525 So. Wasatch #200 Salt Lake City, UT 84124-	LAB NO:	0001528
		GROUP NO:	000297S
		DATE SAMPLED:	11/24/92
		TIME SAMPLED:	1200
ATTN:	Mr. Robert Glascot	DATE RECEIVED:	11/25/92
		DATE REPORTED:	12/10/92
SAMPLE ID:	870-WS-2/59'	DISPOSAL DATE:	01/09/93

-Page 2-

COMPOUND(s)		ANALYTICAL RESULT	LIMIT OF QUANTITATION
1,1,2,2-Tetrachloroethane	<	1.0 ug/l	1.0 ug/l
1,1,2-Trichloroethane	<	1.0 ug/l	1.0 ug/l
1,2-Dichlorobenzene	<	1.0 ug/l	1.0 ug/l
1,3-Dichlorobenzene	<	1.0 ug/l	1.0 ug/l
1,4-Dichlorobenzene	<	1.0 ug/l	1.0 ug/l

Date Analyzed: 12/02/92

*These compounds coelute under the conditions used. The result represents the total amount for these compounds.

Respectfully submitted,

Kenneth A. Roberts

Kenneth A. Roberts, B.S.
GC Group Leader

Analytical Report

Mountain States Analytical

The Quality Solution

CLIENT: J.M. Montgomery Engineers
4525 So. Wasatch #200
Salt Lake City, UT 84124-

ATTN: Mr. Robert Glascot

SAMPLE ID: 870-WS-2/69'

SAMPLE NO: 0001529
SAMPLE SET NO: 000297S
DATE SAMPLED: 11/24/92
TIME SAMPLED: 1315
DATE RECEIVED: 11/25/92
DATE REPORTED: 12/10/92
DISPOSAL DATE: 01/09/93

ANALYSIS: Volatiles - Water Matrix [EPA 601/602] (Capillary)

COMPOUND(s)		RESULT	LIMIT OF QUANTITATION
Chloromethane	<	2.0 ug/l	2.0 ug/l
Vinyl Chloride	<	2.0 ug/l	2.0 ug/l
Bromomethane	<	2.0 ug/l	2.0 ug/l
Chloroethane	<	2.0 ug/l	2.0 ug/l
Fluorotrichloromethane	<	2.0 ug/l	2.0 ug/l
1,1-Dichloroethene	<	1.0 ug/l	1.0 ug/l
Dichloromethane	<	1.0 ug/l	1.0 ug/l
trans-1,2-Dichloroethene	<	1.0 ug/l	1.0 ug/l
1,1-Dichloroethane	<	1.0 ug/l	1.0 ug/l
Chloroform	<	1.0 ug/l	1.0 ug/l
1,1,1-Trichloroethane	<	1.0 ug/l	1.0 ug/l
Carbon Tetrachloride	<	1.0 ug/l	1.0 ug/l
Benzene		43.5 ug/l	1.0 ug/l
1,2-Dichloroethane	<	1.0 ug/l	1.0 ug/l
Trichloroethene (TCE)	<	1.0 ug/l	1.0 ug/l
1,2-Dichloropropane	<	1.0 ug/l	1.0 ug/l
Bromodichloromethane	<	1.0 ug/l	1.0 ug/l
cis-1,3-Dichloropropene	<	1.0 ug/l	1.0 ug/l
trans-1,3-Dichloropropene	<	1.0 ug/l	1.0 ug/l
Toluene		71.7 ug/l	1.0 ug/l
Tetrachloroethene (PCE)	<	1.0 ug/l	1.0 ug/l
Chlorodibromomethane	<	1.0 ug/l	1.0 ug/l
Chlorobenzene	<	1.0 ug/l	1.0 ug/l
Ethylbenzene		38.2 ug/l	1.0 ug/l
Bromoform	<	2.0 ug/l	2.0 ug/l
m,p-Xylene		258 ug/l	50.0 ug/l
o-Xylene/Styrene*		63.6 ug/l	1.0 ug/l

-Continued-

Mountain States Analytical

The Quality Solution

James M. Montgomery Engineers
4525 South Wasatch Blvd., Suite 200
Salt Lake City, UT 84124
Telephone: (801) 272-1900
Facsimile: (801) 272-0403

Sample Number: 0001529
Sample Set: 000297S
Date Reported: 10 DEC 1992
Date Received: 25 NOV 1992
Disposal Date: 8 JAN 1993

Attention: Robert Glascot
Project: HAFB USTs
Case Number: VOCs/BTEXN
Purchase Order: 2208.0585

Customer Number: 870-WS-2/69'
Date Sampled: 24 NOV 1992
Matrix: Water/Waste Water
Containers: 2

Analysis	Catalog Number	Method	Result	Dry Result	Reporting Units
Volatile Aromatics/Halocarbons	05515	EPA 600 Series 601/ 602	See Attached		

1 Analysis for GC

Reviewed and approved by
Kenneth Roberts, B.S.
GC Group Leader

1 Analysis for Sample Number 0001529

Mountain States Analytical

The Quality Solution

CLIENT: J.M. Montgomery Engineers
4525 S Wasatch #200
Salt Lake City, UT 84124

ATTN: Mr. David Fulton

SAMPLE ID: CPT-10

LAB NO: 36821
GROUP NO: 9132
DATE SAMPLED: 10/19/92
TIME SAMPLED: 1700
DATE RECEIVED: 10/20/92
DATE REPORTED: 10/21/92
DISPOSAL DATE: 11/20/92
ANALYSIS DATE: 10/20/92

ANALYSIS: Priority Pollutants by GCMS (Volatiles)
EPA Method SW-846 8240

COMPOUNDS	FINAL RESULTS	QUANTITATION LIMIT
Chloromethane	<10 ug/l	10 ug/l
Vinyl Chloride	<10 ug/l	10 ug/l
Bromomethane	<10 ug/l	10 ug/l
Chloroethane	<10 ug/l	10 ug/l
Trichlorofluoromethane	<5 ug/l	5 ug/l
Acrolein	<100 ug/l	100 ug/l
1,1-Dichloroethene	<5 ug/l	5 ug/l
Methylene Chloride	12 ug/l	5 ug/l
Acrylonitrile	<100 ug/l	100 ug/l
1,1-Dichloroethane	<5 ug/l	5 ug/l
1,2-Dichloroethene (total)	<5 ug/l	5 ug/l
Chloroform	<5 ug/l	5 ug/l
1,1,1-Trichloroethane	<5 ug/l	5 ug/l
Carbon Tetrachloride	<5 ug/l	5 ug/l
Benzene	<5 ug/l	5 ug/l
1,2-Dichloroethane	<5 ug/l	5 ug/l
Trichloroethene	<5 ug/l	5 ug/l
1,2-Dichloropropane	<5 ug/l	5 ug/l
Bromodichloromethane	<5 ug/l	5 ug/l
2-Chloroethylvinyl ether	<10 ug/l	10 ug/l
cis-1,3-Dichloropropene	<5 ug/l	5 ug/l
Toluene	11 ug/l	5 ug/l
trans-1,3-Dichloropropene	<5 ug/l	5 ug/l
1,1,2-Trichloroethane	<5 ug/l	5 ug/l
Tetrachloroethene	<5 ug/l	5 ug/l
Dibromochloromethane	<5 ug/l	5 ug/l
Chlorobenzene	<5 ug/l	5 ug/l
Ethylbenzene	16 ug/l	5 ug/l
Xylenes (Total)	160 ug/l	5 ug/l
Bromoform	<5 ug/l	5 ug/l
1,1,2,2-Tetrachloroethane	<5 ug/l	5 ug/l

-Continued-

Analytical Report

Mountain States Analytical

The Quality Solution

CLIENT:	J.M. Montgomery Engineers 4525 So. Wasatch #200 Salt Lake City, UT 84124-	Date Samples Rec'd:	10/20/92
		MSAI Group No.:	9132
		Sample Matrix:	Aqueous
Phone:	801-272-1900 801-272-0430 (FAX)	Report Date:	10/22/92
ATTN:	Mr. David Fulton	P.O. Number:	
Project:	UST Site 870 2208.0402		

LAB NO.	SAMPLE DATE	SAMP TIME	SAMPLE DESCRIPTION	ANALYSES PERFORMED	RESULT
36281	10/19/92	1700	CPT-10	PP Volatiles 8240 GCMS	See Attach ---

Respectfully submitted,

Douglas W. Later, Ph.D.
Laboratory Director

Glenn A. Sorensen, B.S.
Manager, Technical Operations

1645 West 2200 South, Salt Lake City, Utah 84119 (801) 973-0050 FAX (801) 972-6278

Analytical Report

Mountain States Analytical

The Quality Solution

CLIENT:	James M. Montgomery Engineers 4525 South Wasatch Blvd. Salt Lake City, UT 84124	LAB NO:	3135
		GROUP NO:	665S
		DATE SAMPLED:	12/18/92
		TIME SAMPLED:	1145
ATTN:	Mr. Robert Glascot	DATE RECEIVED:	12/18/92
		DATE REPORTED:	01/11/93
SAMPLE ID:	CPT-14	DISPOSAL DATE:	02/10/93
PROJECT:	HAFB UST	ANALYSIS DATE:	01/01/93

ANALYSIS: Priority Pollutants by GCMS (Volatiles)
EPA Method SW-846 8240

COMPOUNDS	FINAL RESULTS	QUANTITATION LIMIT
Chloromethane	< 500,000 ug/l	500,000 ug/l
Vinyl Chloride	< 500,000 ug/l	500,000 ug/l
Bromomethane	< 500,000 ug/l	500,000 ug/l
Chloroethane	< 500,000 ug/l	500,000 ug/l
Trichlorofluoromethane	< 250,000 ug/l	250,000 ug/l
Acrolein	<1000,000 ug/l	1000,000 ug/l
1,1-Dichloroethene	< 250,000 ug/l	250,000 ug/l
Methylene Chloride	< 250,000 ug/l	250,000 ug/l
Acrylonitrile	<1000,000 ug/l	1000,000 ug/l
1,1-Dichloroethane	< 250,000 ug/l	250,000 ug/l
1,2-Dichloroethene (total)	< 250,000 ug/l	250,000 ug/l
Chloroform	< 250,000 ug/l	250,000 ug/l
1,1,1-Trichloroethane	< 250,000 ug/l	250,000 ug/l
Carbon Tetrachloride	< 250,000 ug/l	250,000 ug/l
Benzene	< 250,000 ug/l	250,000 ug/l
1,2-Dichloroethane	< 250,000 ug/l	250,000 ug/l
Trichloroethene	< 250,000 ug/l	250,000 ug/l
1,2-Dichloropropane	< 250,000 ug/l	250,000 ug/l
Bromodichloromethane	< 250,000 ug/l	250,000 ug/l
2-Chloroethylvinyl ether	< 500,000 ug/l	500,000 ug/l
cis-1,3-Dichloropropene	< 250,000 ug/l	250,000 ug/l
Toluene	< 250,000 ug/l	250,000 ug/l
trans-1,3-Dichloropropene	< 250,000 ug/l	250,000 ug/l
1,1,2-Trichloroethane	< 250,000 ug/l	250,000 ug/l
Tetrachloroethene	< 250,000 ug/l	250,000 ug/l
Dibromochloromethane	< 250,000 ug/l	250,000 ug/l
Chlorobenzene	< 250,000 ug/l	250,000 ug/l
Ethylbenzene	1,400,000 ug/l	250,000 ug/l
Xylenes (Total)	13,000,000 ug/l	250,000 ug/l

-Continued-

1645 West 2200 South, Salt Lake City, Utah 84119 (801) 973-0050 FAX (801) 972-6278

Mountain States Analytical

The Quality Solution

James M. Montgomery Engineers
4525 South Wasatch Blvd., Suite 200
Salt Lake City, UT 84124
Telephone: (801) 272-1900
Facsimile: (801) 272-0403

Sample Number: 0003135
Sample Set: 000665S
Date Reported: 6 JAN 1993
Date Received: 18 DEC 1992
Disposal Date: 2 FEB 1993

Attention: Robert Glascot
Project: HAFB UST
Case Number:
Purchase Order: 2208.0580

Customer Number: CPT-14
Date Sampled: 18 DEC 1992
Matrix: Combustible Liquids
Containers: 2

Analysis	Catalog Number	Method	Result	Dry Result	Reporting Units
Priority Pollutant Volatile Organics	01177	EPA SW-846 8240	See Attached		

1 Analysis for GC/MS

Reviewed and approved by
John Hayes, B.S.
Supervisor, GCMS Group

1 Analysis for Sample Number 0003135

Mountain States Analytical

The Quality Solution

CLIENT:	J.M. Montgomery Engineers 4525 So. Wasatch #200 Salt Lake City, UT 84124-	SAMPLE NO:	0001530
		SAMPLE SET NO:	000297S
		DATE SAMPLED:	11/24/92
		TIME SAMPLED:	1345
ATTN:	Mr. Robert Glascot	DATE RECEIVED:	11/25/92
		DATE REPORTED:	12/10/92
SAMPLE ID:	CPT-40	DISPOSAL DATE:	01/09/93

ANALYSIS: Volatiles - Water Matrix [EPA 601/602] (Capillary)

COMPOUND(s)		RESULT	LIMIT OF QUANTITATION
Chloromethane	<	2.0 ug/l	2.0 ug/l
Vinyl Chloride	<	2.0 ug/l	2.0 ug/l
Bromomethane	<	2.0 ug/l	2.0 ug/l
Chloroethane	<	2.0 ug/l	2.0 ug/l
Fluorotrichloromethane	<	2.0 ug/l	2.0 ug/l
1,1-Dichloroethene	<	1.0 ug/l	1.0 ug/l
Dichloromethane	<	1.0 ug/l	1.0 ug/l
trans-1,2-Dichloroethene	<	1.0 ug/l	1.0 ug/l
1,1-Dichloroethane	<	1.0 ug/l	1.0 ug/l
Chloroform	<	1.0 ug/l	1.0 ug/l
1,1,1-Trichloroethane	<	1.0 ug/l	1.0 ug/l
Carbon Tetrachloride	<	1.0 ug/l	1.0 ug/l
Benzene	<	1.0 ug/l	1.0 ug/l
1,2-Dichloroethane	<	1.0 ug/l	1.0 ug/l
Trichloroethene (TCE)	<	1.0 ug/l	1.0 ug/l
1,2-Dichloropropane	<	1.0 ug/l	1.0 ug/l
Bromodichloromethane	<	1.0 ug/l	1.0 ug/l
cis-1,3-Dichloropropene	<	1.0 ug/l	1.0 ug/l
trans-1,3-Dichloropropene	<	1.0 ug/l	1.0 ug/l
Toluene	<	1.0 ug/l	1.0 ug/l
Tetrachloroethene (PCE)	<	1.0 ug/l	1.0 ug/l
Chlorodibromomethane	<	1.0 ug/l	1.0 ug/l
Chlorobenzene	<	1.0 ug/l	1.0 ug/l
Ethylbenzene	<	1.0 ug/l	1.0 ug/l
Bromoform	<	2.0 ug/l	2.0 ug/l
m,p-Xylene	<	1.0 ug/l	1.0 ug/l
o-Xylene/Styrene*	<	1.0 ug/l	1.0 ug/l

-Continued-

Analytical Report

Mountain States Analytical

The Quality Solution

CLIENT:	J.M. Montgomery Engineers 4525 So. Wasatch #200 Salt Lake City, UT 84124-	LAB NO:	0001530
		GROUP NO:	000297S
		DATE SAMPLED:	11/24/92
		TIME SAMPLED:	1345
ATTN:	Mr. Robert Glascot	DATE RECEIVED:	11/25/92
		DATE REPORTED:	12/10/92
SAMPLE ID:	CPT-40	DISPOSAL DATE:	01/09/93

-Page 2-

COMPOUND(s)		FINAL RESULT	LIMIT OF QUANTITATION
1,1,2,2-Tetrachloroethane	<	1.0 ug/l	1.0 ug/l
1,1,2-Trichloroethane	<	1.0 ug/l	1.0 ug/l
1,2-Dichlorobenzene	<	1.0 ug/l	1.0 ug/l
1,3-Dichlorobenzene	<	1.0 ug/l	1.0 ug/l
1,4-Dichlorobenzene	<	1.0 ug/l	1.0 ug/l

Date Analyzed: 12/02/92

*These compounds coelute under the conditions used. The result represents the total amount for these compounds.

Respectfully submitted,

Kenneth A. Roberts

Kenneth A. Roberts, B.S.
GC Group Leader

Mountain States Analytical

The Quality Solution

CLIENT: J.M. Montgomery Engineers
4525 So Wasatch #200
Salt Lake City, UT 84124-

ATTN: Mr. Robert Glascot

SAMPLE ID: CPT-42

SAMPLE NO: 0001531
SAMPLE SET NO: 000297S
DATE SAMPLED: 11/24/92
TIME SAMPLED: 1455
DATE RECEIVED: 11/25/92
DATE REPORTED: 12/09/92
DISPOSAL DATE: 01/08/93

ANALYSIS: Gasoline Contamination in Water (BTEX) [EPA 602]

COMPOUND(s)	RESULT	LIMIT OF QUANTITATION
Benzene	< 1.0 ug/l	1.0 ug/l
Toluene	< 1.0 ug/l	1.0 ug/l
Ethylbenzene	< 1.0 ug/l	1.0 ug/l
m,p-Xylene	< 1.0 ug/l	1.0 ug/l
o-Xylene/Styrene*	< 1.0 ug/l	1.0 ug/l
~~Naphthalene~~	< 1.0 ug/l	1.0 ug/l

Date Analyzed: 12/03/92

*These compounds coelute under the conditions used. The result represents the total amount for these compounds.

Respectfully submitted,

Kenneth A. Roberts

Kenneth A. Roberts, B.S.
GC Group Leader

1645 West 2200 South, Salt Lake City, Utah 84119 (801) 973-0050 FAX (801) 972-6278

Mountain States Analytical

The Quality Solution

James M. Montgomery Engineers
4525 South Wasatch Blvd., Suite 200
Salt Lake City, UT 84124
Telephone: (801) 272-1900
Facsimile: (801) 272-0403

Sample Number: 0001532
Sample Set: 000297S
Date Reported: 10 DEC 1992
Date Received: 25 NOV 1992
Disposal Date: 8 JAN 1993

Attention: Robert Glascot
Project: HAFB USTs
Case Number: VOCs/BTEXN
Purchase Order: 2208.0585

Customer Number: CPT-43
Date Sampled: 24 NOV 1992
Matrix: Water/Waste Water
Containers: 1

Analysis	Catalog Number	Method	Result	Dry Result	Reporting Units
Btex & Naphthalene	04264	EPA 602 SW-846 5030/8020	See Attached		

1 Analysis for GC

Reviewed and approved by
Kenneth Roberts, B.S.
GC Group Leader

1 Analysis for Sample Number 0001532

Analytical Report

Mountain States Analytical

The Quality Solution

CLIENT:	J.M. Montgomery Engineers 4525 So Wasatch Dr. #200 Salt Lake City, UT 84124-	SAMPLE NO:	0001634
		SAMPLE SET NO:	000322S
		DATE SAMPLED:	11/30/92
		TIME SAMPLED:	1350
ATTN:	Mr. Robert Glascot	DATE RECEIVED:	12/01/92
		DATE REPORTED:	12/10/92
SAMPLE ID:	CPT-42	DISPOSAL DATE:	01/09/93

ANALYSIS: Gasoline Contamination in Water (BTEX) [EPA 602]

COMPOUND(s)		RESULT	LIMIT OF QUANTITATION
Benzene	<	1.0 ug/l	1.0 ug/l
Toluene	<	1.0 ug/l	1.0 ug/l
Ethylbenzene	<	1.0 ug/l	1.0 ug/l
m,p-Xylene	<	1.0 ug/l	1.0 ug/l
o-Xylene/Styrene*	<	1.0 ug/l	1.0 ug/l
Naphthalene	<	1.0 ug/l	1.0 ug/l

Date Analyzed: 12/03/92

*These compounds coelute under the conditions used. The result represents the total amount for these compounds.

Respectfully submitted,

Kenneth A. Roberts

Kenneth A. Roberts, B.S.
GC Group Leader

Mountain States Analytical
The Quality Solution

James M. Montgomery Engineers
4525 South Wasatch Blvd., Suite 200
Salt Lake City, UT 84124
Telephone: (801) 272-1900
Facsimile: (801) 272-0403

Sample Number: 0001634
Sample Set: 000322S
Date Reported: 14 DEC 1992
Date Received: 1 DEC 1992
Disposal Date: 18 JAN 1993

Attention: Robert Glascot
Project: Hill AFB
Case Number: BTEXN
Purchase Order: 2208.0585

Customer Number: CPT-42
Date Sampled: 30 NOV 1992
Matrix: Wastewater
Containers: 2

Analysis	Catalog Number	Method	Result	Dry Result	Reporting Units
Btex & Naphthalene	04264	EPA SW-846 5030/ 8020	See Attached		

1 Analysis for GC

Reviewed and approved by
Kenneth Roberts, B.S.
GC Group Leader

1 Analysis for Sample Number 0001634

Mountain States Analytical

The Quality Solution

CLIENT: J.M. Montgomery Engineers
4525 So Wasatch #200
Salt Lake City, UT 84124-

ATTN: Mr. Robert Glascot

SAMPLE ID: CPT-43

SAMPLE NO: 0001532
SAMPLE SET NO: 000297S
DATE SAMPLED: 11/24/92
TIME SAMPLED: 1600
DATE RECEIVED: 11/25/92
DATE REPORTED: 12/09/92
DISPOSAL DATE: 01/08/93

ANALYSIS: Gasoline Contamination in Water (BTEX) [EPA 602]

COMPOUND(s)		RESULT	LIMIT OF QUANTITATION
Benzene	<	1.0 ug/l	1.0 ug/l
Toluene	<	1.0 ug/l	1.0 ug/l
Ethylbenzene	<	1.0 ug/l	1.0 ug/l
m,p-Xylene	<	1.0 ug/l	1.0 ug/l
o-Xylene/Styrene*	<	1.0 ug/l	1.0 ug/l
~~Naphthalene~~	<	1.0 ug/l	1.0 ug/l

Date Analyzed: 12/03/92

*These compounds coelute under the conditions used. The result represents the total amount for these compounds.

Respectfully submitted,

Kenneth A. Roberts

Kenneth A. Roberts, B.S.
GC Group Leader

1645 West 2200 South, Salt Lake City, Utah 84119 (801) 973-0050 FAX (801) 972-6278

CHAIN OF CUSTODY RECORD/LAB WORK REQUEST

Chain of Custody Number ______
Cooler Number ______
Lot Control ID ______
Page ______ of ______
Air Bill No. ______

LABORATORY Mt States Analytical

MONTGOMERY WATSON, INC.
Phone (801) 272-1900 FAX (801) 272-0430

MW Contact Glezzut / Fulton
Project HAFB USTs
Project Number 2248.1585
Date Due Std. TAT (2 wk)
Samplers Signature Robert L. Bierney (RLB)

Lab ID No. (Lab Only)	Location ID / Sample ID	Depth Interval (ft)	Date Collected	Time Collected	Matrix[1]	Sampling Technique[2]	Number of Containers (Total)	VOC 05515	BNAE	Pest/PCB	Dioxin/Furan	TPH MOD	Metals	Cyanide	TCLP-Metals VOC BNAE Pest.	BTEX+N				
	870-WS-1/32'		11/23/92	1500	WG	G	3	✓												
	870-WS-1/42'		11/23/92	1630	WG	G	3	✓												
	Trip Blank 11/23/92		11/23/92				2	✓	~~sent only 1 vial~~											
	870-WS-2/49'		11/24/92	1015	WG	G	2	✓												
	MW-60		11/24/92	0800	WG	G	3	✓												
	870-WS-2/59'		11/24/92	1200	WG	G	3	✓												
	870-WS-2/65'		11/24/92	1315	WG	G	2	✓								04284				
	CPT-40		11/24/92	1345	WG	G	2	✓												
Broken	CPT-42 – one vial		11/24/92	1455	WG	G	2									✓				
Broken	CPT-41 – no vials		11/24/92	1540	WG	G	2									✓				
Broken	CPT-43 – one vial		11/24/92	1600	WG	G	2									✓				
	870-WS-1/52'		11/24/92	0830	WG	G	3	✓												

[1] Matrix:
SO - Soil
SE - Sediment
WS - Surface Water
WG - Ground Water
LF - Product
AA - Air
SW - Wipe
DC - Drum Solids
LD - Drum Liquids
EP/TCLP Leachate

[2] Sampling Technique:
Composite=C
Grab=G

SPECIAL INSTRUCTIONS (i.e. metals list...):
Note: Please try to keep the detection limits as low as possible again we're looking for PCE at very low levels (ppb) Note CPT-41 (+) contains no preservative.

Relinquished by	Received by	Date	Time
[signature]	Rupal Olsen	11/25/92	0800

Relinquished by	Received by	Date	Time

LABORATORY USE ONLY

SAMPLES WERE:

1 Shipped or hand delivered
Notes:

2 Ambient or Chilled
Notes:

3 Temperature ______

4 Received Broken/Leaking (Improperly Sealed)
Y N
Notes:

5 Properly Preserved
Y N
Notes:

6 Received Within Holding Times
Y N
Notes:

COC Tape Was:

1 Present on Outer Package
Y N NA

2 Unbroken on Outer Package
Y N NA

3 Present on Sample
Y N NA

4 Unbroken on Sample
Y N NA
Notes

Discrepancies Between Sample Labels and COC Record?
Y N
Notes:

Analytical Report

Mountain States Analytical

The Quality Solution

CLIENT:	J.M. Montgomery Engineers 4525 So Wasatch Dr. #200 Salt Lake City, UT 84124-	SAMPLE NO:	0001635
		SAMPLE SET NO:	000322S
		DATE SAMPLED:	11/30/92
		TIME SAMPLED:	1410
ATTN:	Mr. Robert Glascot	DATE RECEIVED:	12/01/92
		DATE REPORTED:	12/10/92
SAMPLE ID:	CPT-43	DISPOSAL DATE:	01/09/93

ANALYSIS: Gasoline Contamination in Water (BTEX) [EPA 602]

COMPOUND(s)		RESULT	LIMIT OF QUANTITATION
Benzene	<	1.0 ug/l	1.0 ug/l
Toluene	<	1.0 ug/l	1.0 ug/l
Ethylbenzene	<	1.0 ug/l	1.0 ug/l
m,p-Xylene	<	1.0 ug/l	1.0 ug/l
o-Xylene/Styrene*	<	1.0 ug/l	1.0 ug/l
Naphthalene	<	1.0 ug/l	1.0 ug/l

Date Analyzed: 12/03/92

*These compounds coelute under the conditions used. The result represents the total amount for these compounds.

Respectfully submitted,

Kenneth A. Roberts

Kenneth A. Roberts, B.S.
GC Group Leader

Analytical Report

Mountain States Analytical

The Quality Solution

James M. Montgomery Engineers
4525 South Wasatch Blvd., Suite 200
Salt Lake City, UT 84124
Telephone: (801) 272-1900
Facsimile: (801) 272-0403

Sample Number:	0001635
Sample Set:	000322S
Date Reported:	14 DEC 1992
Date Received:	1 DEC 1992
Disposal Date:	18 JAN 1993

Attention:	Robert Glascot
Project:	Hill AFB
Case Number:	BTEXN
Purchase Order:	2208.0585

Customer Number:	CPT-43
Date Sampled:	30 NOV 1992
Matrix:	Wastewater
Containers:	2

Analysis	Catalog Number	Method	Result	Dry Result	Reporting Units
Btex & Naphthalene	04264	EPA SW-846 5030/ 8020	See Attached		

1 Analysis for GC

Reviewed and approved by
Kenneth Roberts, B.S.
GC Group Leader

1 Analysis for Sample Number 0001635

MONTGOMERY LABORATORIES
555 East Walnut Street, P.O. Box 7009
Pasadena, California 91109-7009
(818) 796-9141

Laboratory Report

Hill Air Force Base/JMM-SLC
4525 Wasatch Blvd

Salt Lake City , UT 84214
ATTN: Dave Fulton

Sample # 920810001 Sample ID CPT-7 Project VOA
Sample Type Water Sampled 07-aug-1992 Received 08-aug-1992 Reported 14-aug-1992

Volatile Organics HSL (ML/SW 8240)

Parameter	Units	Result	%Rec Conc.	Dilution	Det.Limit	Prepared	By	Analyzed	By
1,1,2-Trichloroethane (1,1,2-T	ug/l	ND		1000	500			13-aug-1992	jhc
1,1-Dichloroethylene (1,1DCE)	ug/l	ND		1000	500			13-aug-1992	jhc
1,1-Dichloroethane	ug/l	ND		1000	500			13-aug-1992	jhc
1,2-Dichlorobenzene	ug/l	ND		1000	500			13-aug-1992	jhc
1,2-Dichloroethane	ug/l	ND		1000	500			13-aug-1992	jhc
1,2-Dichloropropane	ug/l	ND		1000	500			13-aug-1992	jhc
1,3-Dichlorobenzene	ug/l	ND		1000	500			13-aug-1992	jhc
1,4-Dichlorobenzene (p-DCB)	ug/l	ND		1000	500			13-aug-1992	jhc
2-Butanone (MEK)	ug/l	ND		1000	10000			13-aug-1992	jhc
2-Chloroethylvinylether	ug/l	ND		1000	1000			13-aug-1992	jhc
2-Hexanone	ug/l	ND		1000	10000			13-aug-1992	jhc
4-Methyl-2-Pentanone (MIBK)	ug/l	ND		1000	1000			13-aug-1992	jhc
Acetone	ug/l	ND		1000	10000			13-aug-1992	jhc
Acrolein	ug/l	ND		1000	1000			13-aug-1992	jhc
Acrylonitrile	ug/l	ND		1000	1000			13-aug-1992	jhc
Benzene	ug/l	ND		1000	500			13-aug-1992	jhc
cis-1,2-Dichloroethene	ug/l	ND		1000	500			13-aug-1992	jhc
Chlorobenzene	ug/l	ND		1000	500			13-aug-1992	jhc
cis-1,3-Dichloropropene	ug/l	ND		1000	500			13-aug-1992	jhc
Bromoform	ug/l	ND		1000	500			13-aug-1992	jhc
Chloroform (Trichloromethane)	ug/l	ND		1000	500			13-aug-1992	jhc
Chloroethane	ug/l	ND		1000	1000			13-aug-1992	jhc
Carbon disulfide	ug/l	ND		1000	500			13-aug-1992	jhc
Carbon Tetrachloride	ug/l	ND		1000	500			13-aug-1992	jhc
Dibromochloromethane	ug/l	ND		1000	500			13-aug-1992	jhc
Dichlorobromomethane	ug/l	ND		1000	500			13-aug-1992	jhc
Ethyl benzene	ug/l	1800		1000	500			13-aug-1992	jhc
Methyl Bromide	ug/l	ND		1000	1000			13-aug-1992	jhc
Methyl Chloride	ug/l	ND		1000	1000			13-aug-1992	jhc

Report #: 2253

MONTGOMERY LABORATORIES
555 East Walnut Street, P.O. Box 7009
Pasadena, California 91109-7009
(818) 796-9141

Laboratory Report

Hill Air Force Base/JMM-SLC
4525 Wasatch Blvd

Salt Lake City , UT 84214
ATTN: Dave Fulton

Sample # 920810001 Sample ID CPT-7 Project VOA
Sample Type Water Sampled 07-aug-1992 Received 08-aug-1992 Reported 14-aug-1992

Volatile Organics HSL (ML/SW 8240)

Parameter	Units	Result	%Rec Conc.	Dilution	Det.Limit	Prepared	By	Analyzed	By
Methylene Chloride	ug/l	ND		1000	3000			13-aug-1992	jhc
m,p-Xylenes	ug/l	4600		1000	500			13-aug-1992	jhc
o-Xylene	ug/l	1900		1000	500			13-aug-1992	jhc
1,1,2,2-Tetrachloroethane	ug/l	ND		1000	500			13-aug-1992	jhc
Tetrachloroethylene (PCE)	ug/l	ND		1000	500			13-aug-1992	jhc
Styrene	ug/l	ND		1000	500			13-aug-1992	jhc
trans-1,2-Dichloroethene	ug/l	ND		1000	500			13-aug-1992	jhc
1,1,1-Trichloroethane	ug/l	ND		1000	500			13-aug-1992	jhc
Trichloroethylene (TCE)	ug/l	ND		1000	500			13-aug-1992	jhc
Trichlorofluoromethane	ug/l	ND		1000	1000			13-aug-1992	jhc
trans-1,3-Dichloropropene	ug/l	ND		1000	500			13-aug-1992	jhc
Tetrahydrofuran	ug/l	ND		1000	10000			13-aug-1992	jhc
Toluene	ug/l	ND		1000	500			13-aug-1992	jhc
Vinyl Chloride (VC)	ug/l	ND		1000	1000			13-aug-1992	jhc
Vinyl Acetate	ug/l	ND		1000	10000			13-aug-1992	jhc

Report #: 2253

Mountain States Analytical

The Quality Solution

CLIENT: J.M. Montgomery Engineers
4525 S. Wasatch #200
Salt Lake City, UT 84124

ATTN: Mr. David Fulton

SAMPLE ID: CPT-7

LAB NO:	34822
GROUP NO:	8810
DATE SAMPLED:	09/30/92
TIME SAMPLED:	1000
DATE RECEIVED:	10/02/92
DATE REPORTED:	10/21/92
DISPOSAL DATE:	11/20/92
ANALYSIS DATE:	10/09/92

ANALYSIS: Priority Pollutants by GCMS (Volatiles)
EPA Method SW-846 8240

COMPOUNDS	FINAL RESULTS	QUANTITATION LIMIT
Chloromethane	* 71 ug/l	50 ug/l
Vinyl Chloride	<500 ug/l	500 ug/l
Bromomethane	<500 ug/l	500 ug/l
Chloroethane	<500 ug/l	500 ug/l
Trichlorofluoromethane	<250 ug/l	250 ug/l
Acrolein	<5,00ug/l	5,000 ug/l
1,1-Dichloroethene	<250 ug/l	250 ug/l
Methylene Chloride	<250 ug/l	250 ug/l
Acrylonitrile	<5,00ug/l	5,000 ug/l
1,1-Dichloroethane	<250 ug/l	250 ug/l
1,2-Dichloroethene (total)	<250 ug/l	250 ug/l
Chloroform	<250 ug/l	250 ug/l
1,1,1-Trichloroethane	<250 ug/l	250 ug/l
Carbon Tetrachloride	<250 ug/l	250 ug/l
Benzene	680 ug/l	250 ug/l
1,2-Dichloroethane	<250 ug/l	250 ug/l
Trichloroethene	<250 ug/l	250 ug/l
1,2-Dichloropropane	<250 ug/l	250 ug/l
Bromodichloromethane	<250 ug/l	250 ug/l
2-Chloroethylvinyl ether	<500 ug/l	500 ug/l
cis-1,3-Dichloropropene	<250 ug/l	250 ug/l
Toluene	* 34 ug/l J	50 ug/l
trans-1,3-Dichloropropene	<250 ug/l	250 ug/l
1,1,2-Trichloroethane	<250 ug/l	250 ug/l
Tetrachloroethene	* <50 ug/l	50 ug/l
Dibromochloromethane	<250 ug/l	250 ug/l
Chlorobenzene	<250 ug/l	250 ug/l
Ethylbenzene	1,400ug/l	250 ug/l
Xylenes (Total)	5,700ug/l	250 ug/l

J - estimated value

-Continued-

1645 West 2200 South, Salt Lake City, Utah 84119 (801) 973-0050 FAX (801) 972-6278

Analytical Report

Mountain States Analytical

The Quality Solution

CLIENT: J.M. Montgomery Engineers
4525 So. Wasatch #200
Salt Lake City, UT 84124-
Phone: 801-272-1900 801-272-0430 (FAX)
ATTN: Mr. David Fulton
Project: HAFB UST Site 870

Date Samples Rec'd: 10/02/92
MSAI Group No.: 8810
Sample Matrix: Aqueous
Report Date: 10/20/92
P.O. Number: 2208.0402

LAB NO.	SAMPLE DATE	SAMP TIME	SAMPLE DESCRIPTION	ANALYSES PERFORMED	RESULT
34822	09/30/92	1000	CPT-7	PP Volatiles 8240 GCMS	See Attach ---
34823	09/30/92	1320	T-870-5-MW-U-92-HF	PP Volatiles 8240 GCMS	See Attach ---
34824	09/30/92	1100	T-870-27-MW-U-92-HF	PP Volatiles 8240 GCMS	See Attach ---
34825	09/30/92	1325	T-870-11-MW-U-92-HF	PP Volatiles 8240 GCMS	See Attach ---
34826	10/01/92	1200	T-870-12-MW-U-92-HF	PP Volatiles 8240 GCMS	See Attach ---
34827	10/01/92	1500	T-870-10-MW-U-92-HF	PP Volatiles 8240 GCMS	See Attach ---
34828	10/01/92	0	Trip Blank	PP Volatiles 8240 GCMS	See Attach ---

Respectfully submitted,

for

Douglas W. Later, Ph.D.
Laboratory Director

Glenn A. Sorensen
Glenn A. Sorensen, B.S.
Manager, Technical Operations

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT: James M. Montgomery
4525 S. Wasatch Blvd.
SLC, Utah 84124

Attn: David A. Fulton

PROJECT NO. : 92-1016
SAMPLE NO. : 143
REPORT DATE : 10/09/92
REVIEWED BY : RAK
PAGE : 1 OF 2

CLIENT ID NO. : None
SAMPLE MATRIX : Ground Water
SAMPLED BY : NKT/RAK
SAMPLE SOURCE : GWS-01
ANALYST : NKT

AUTHORIZED BY : DAF
CLIENT P.O. : None
SAMPLE DATE : 08/14/92
SUBMITTAL DATE: 08/14/92
ANALYSIS DATE : 08/14/92

Organic Monitoring-Drinking Water Volatiles
Full Suite

Sample Analysis

Parameter	Result	Unit	Detection Level
Benzene	0.195	mg/L	0.005
Bromobenzene	N/A	mg/L	0.005
Bromochloromethane	N/A	mg/L	0.005
Bromodichloromethane	N/A	mg/L	0.005
Bromoform	N/A	mg/L	0.005
Bromomethane	N/A	mg/L	0.005
n-Butylbenzene	N/A	mg/L	0.005
sec-Butylbenzene	N/A	mg/L	0.005
tert-Butylbenzene	N/A	mg/L	0.005
Carbon tetrachloride	N/A	mg/L	0.005
Chlorobenzene	N/A	mg/L	0.005
Chloroethane	N/A	mg/L	0.005
Chloroform	N/A	mg/L	0.005
Chloromethane	N/A	mg/L	0.005
2-Chlorotoluene (ortho) ...	N/A	mg/L	0.005
4-Chlorotoluene (para)	N/A	mg/L	0.005
1,2-Dibromoethane (EDB) ...	N/A	mg/L	0.005
1,2-Dibromo-3-chloropropane	N/A	mg/L	0.005
Dibromochloromethane	N/A	mg/L	0.005
Dibromomethane	N/A	mg/L	0.005
1,2-Dichlorobenzene (ortho)	N/A	mg/L	0.005
1,3-Dichlorobenzene (meta)	N/A	mg/L	0.005
1,4-Dichlorobenzene (para)	N/A	mg/L	0.005
Dichlorodifluoromethane ...	N/A	mg/L	0.005
1,1-Dichloroethane	N/A	mg/L	0.005
1,2-Dichloroethane	N/A	mg/L	0.005

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT: James M. Montgomery
4525 S. Wasatch Blvd.
SLC, Utah 84124

SAMPLE SOURCE: GWS-01

PROJECT NO. : 92-1016
SAMPLE NO. : 143
REPORT DATE : 10/09/92
REVIEWED BY : RAK

Sample Analysis

Parameter	Result	Unit	Detection Level
cis 1,2-Dichloroethene	N/A	mg/L	0.005
trans 1,2-Dichloroethene ..	N/A	mg/L	0.005
1,2-Dichloropropane	N/A	mg/L	0.005
1,3-Dichloropropane	N/A	mg/L	0.005
2,2-Dichloropropane	N/A	mg/L	0.005
1,1-Dichloropropene	N/A	mg/L	0.005
1,1-Dichloroethene	N/A	mg/L	0.005
cis 1,3-Dichloropropene ...	N/A	mg/L	0.005
trans 1,3-Dichloropropene .	N/A	mg/L	0.005
Ethylbenzene	0.072	mg/L	0.005
Hexachlorobutadiene	N/A	mg/L	0.005
Isoproylbenzene	N/A	mg/L	0.005
4-Isopropyltoluene	N/A	mg/L	0.005
Dichloromethane	N/A	mg/L	0.005
Napthalene	N/A	mg/L	0.005
Propylbenzene	N/A	mg/L	0.005
Styrene	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethane .	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethene (Tetrachloroethylene)	< 0.005	mg/L	0.005
1,1,1,2-Tetrachloroethane .	N/A	mg/L	0.005
Toluene	0.946	mg/L	0.005
1,2,3-Trichlorobenzene	N/A	mg/L	0.005
1,2,4-Trichlorobenzene	N/A	mg/L	0.005
1,1,1-Trichloroethane	N/A	mg/L	0.005
1,1,2-Trichloroethane	N/A	mg/L	0.005
Trichloroethene (TCE)	N/A	mg/L	0.005
Fluorotrichloromethane	N/A	mg/L	0.005
1,2,3-Trichloropropane	N/A	mg/L	0.005
1,2,4-Trimethylbenzene	N/A	mg/L	0.005
1,3,5-Trimethylbenzene	N/A	mg/L	0.005
Vinyl chloride	N/A	mg/L	0.005
p-m-Xylene	0.062	mg/L	0.005
o-Xylene	0.027	mg/L	0.005

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT:	James M. Montgomery 4525 S. Wasatch Blvd. SLC, Utah 84124 Attn: David A. Fulton	PROJECT NO. : SAMPLE NO. : REPORT DATE : REVIEWED BY : PAGE :	92-1016 107 10/09/92 RAK 1 OF 2

CLIENT ID NO. :	None	AUTHORIZED BY :	DAF
SAMPLE MATRIX :	Ground Water	CLIENT P.O. :	None
SAMPLED BY :	JMM Personnel	SAMPLE DATE :	08/06/92
SAMPLE SOURCE :	MW-03	SUBMITTAL DATE:	08/12/92
ANALYST :	NKT	ANALYSIS DATE :	08/12/92

Organic Monitoring-Drinking Water Volatiles
Full Suite

Sample Analysis

Parameter	Result	Unit	Detection Level
Benzene	12.179	mg/L	0.005
Bromobenzene	N/A	mg/L	0.005
Bromochloromethane	N/A	mg/L	0.005
Bromodichloromethane	N/A	mg/L	0.005
Bromoform	N/A	mg/L	0.005
Bromomethane	N/A	mg/L	0.005
n-Butylbenzene	N/A	mg/L	0.005
sec-Butylbenzene	N/A	mg/L	0.005
tert-Butylbenzene	N/A	mg/L	0.005
Carbon tetrachloride	N/A	mg/L	0.005
Chlorobenzene	N/A	mg/L	0.005
Chloroethane	N/A	mg/L	0.005
Chloroform	N/A	mg/L	0.005
Chloromethane	N/A	mg/L	0.005
2-Chlorotoluene (ortho) ...	N/A	mg/L	0.005
4-Chlorotoluene (para)	N/A	mg/L	0.005
1,2-Dibromoethane (EDB) ...	N/A	mg/L	0.005
1,2-Dibromo-3-chloropropane	N/A	mg/L	0.005
Dibromochloromethane	N/A	mg/L	0.005
Dibromomethane	N/A	mg/L	0.005
1,2-Dichlorobenzene (ortho)	N/A	mg/L	0.005
1,3-Dichlorobenzene (meta)	N/A	mg/L	0.005
1,4-Dichlorobenzene (para)	N/A	mg/L	0.005
Dichlorodifluoromethane ...	N/A	mg/L	0.005
1,1-Dichloroethane	N/A	mg/L	0.005
1,2-Dichloroethane	N/A	mg/L	0.005

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT: James M. Montgomery
4525 S. Wasatch Blvd.
SLC, Utah 84124

SAMPLE SOURCE: MW-03

PROJECT NO. : 92-1016
SAMPLE NO. : 107
REPORT DATE : 10/09/92
REVIEWED BY : RAK

Sample Analysis

Parameter	Result	Unit	Detection Level
cis 1,2-Dichloroethene	N/A	mg/L	0.005
trans 1,2-Dichloroethene ..	N/A	mg/L	0.005
1,2-Dichloropropane	N/A	mg/L	0.005
1,3-Dichloropropane	N/A	mg/L	0.005
2,2-Dichloropropane	N/A	mg/L	0.005
1,1-Dichloropropene	N/A	mg/L	0.005
1,1-Dichloroethene	N/A	mg/L	0.005
cis 1,3-Dichloropropene ...	N/A	mg/L	0.005
trans 1,3-Dichloropropene .	N/A	mg/L	0.005
Ethylbenzene	< 0.005	mg/L	0.005
Hexachlorobutadiene	N/A	mg/L	0.005
Isoproylbenzene	N/A	mg/L	0.005
4-Isopropyltoluene	N/A	mg/L	0.005
Dichloromethane	N/A	mg/L	0.005
Napthalene	N/A	mg/L	0.005
Propylbenzene	N/A	mg/L	0.005
Styrene	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethane .	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethene (Tetrachloroethylene)	2.722	mg/L	0.005
1,1,1,2-Tetrachloroethane .	N/A	mg/L	0.005
Toluene	6.728	mg/L	0.005
1,2,3-Trichlorobenzene	N/A	mg/L	0.005
1,2,4-Trichlorobenzene	N/A	mg/L	0.005
1,1,1-Trichloroethane	N/A	mg/L	0.005
1,1,2-Trichloroethane	N/A	mg/L	0.005
Trichloroethene (TCE)	N/A	mg/L	0.005
Fluorotrichloromethane	N/A	mg/L	0.005
1,2,3-Trichloropropane	N/A	mg/L	0.005
1,2,4-Trimethylbenzene	N/A	mg/L	0.005
1,3,5-Trimethylbenzene	N/A	mg/L	0.005
Vinyl chloride	N/A	mg/L	0.005
p-m-Xylene	4.300	mg/L	0.005
o-Xylene	3.369	mg/L	0.005

Analytical Report

Mountain States Analytical

The Quality Solution

CLIENT: J.M. Montgomery Engineers
4525 S Wasatch #200
Salt Lake City, UT 84124

ATTN: Mr. David Fulton

SAMPLE ID: T-870-10-MW-U-92-HF

LAB NO: 34827
GROUP NO: 8810
DATE SAMPLED: 10/01/92
TIME SAMPLED: 1500
DATE RECEIVED: 10/02/92
DATE REPORTED: 10/16/92
DISPOSAL DATE: 11/15/92
ANALYSIS DATE: 10/12/92

ANALYSIS: Priority Pollutants by GCMS (Volatiles)
EPA Method SW-846 8240

COMPOUNDS	FINAL RESULTS	QUANTITATION LIMIT
Chloromethane	<10 ug/l	10 ug/l
Vinyl Chloride	<10 ug/l	10 ug/l
Bromomethane	<10 ug/l	10 ug/l
Chloroethane	<10 ug/l	10 ug/l
Trichlorofluoromethane	<5 ug/l	5 ug/l
Acrolein	<100 ug/l	100 ug/l
1,1-Dichloroethene	<5 ug/l	5 ug/l
Methylene Chloride	<5 ug/l	5 ug/l
Acrylonitrile	<100 ug/l	100 ug/l
1,1-Dichloroethane	<5 ug/l	5 ug/l
1,2-Dichloroethene (total)	<5 ug/l	5 ug/l
Chloroform	<5 ug/l	5 ug/l
1,1,1-Trichloroethane	<5 ug/l	5 ug/l
Carbon Tetrachloride	<5 ug/l	5 ug/l
Benzene	<5 ug/l	5 ug/l
1,2-Dichloroethane	<5 ug/l	5 ug/l
Trichloroethene	<5 ug/l	5 ug/l
1,2-Dichloropropane	<5 ug/l	5 ug/l
Bromodichloromethane	<5 ug/l	5 ug/l
2-Chloroethylvinyl ether	<10 ug/l	10 ug/l
cis-1,3-Dichloropropene	<5 ug/l	5 ug/l
Toluene	17 ug/l	5 ug/l
trans-1,3-Dichloropropene	<5 ug/l	5 ug/l
1,1,2-Trichloroethane	<5 ug/l	5 ug/l
Tetrachloroethene	<5 ug/l	5 ug/l
Dibromochloromethane	<5 ug/l	5 ug/l
Chlorobenzene	<5 ug/l	5 ug/l
Ethylbenzene	<5 ug/l	5 ug/l
Xylenes (Total)	110 ug/l	5 ug/l
Bromoform	<5 ug/l	5 ug/l
1,1,2,2-Tetrachloroethane	<5 ug/l	5 ug/l

Respectfully submitted,

John G. Hayes

John G. Hayes, B.S.
Supervisor, GCMS Group

Analytical Report

Mountain States Analytical

The Quality Solution

CLIENT:	J.M. Montgomery Engineers 4525 S Wasatch #200 Salt Lake City, UT 84124	LAB NO:	34826
		GROUP NO:	8810
		DATE SAMPLED:	10/01/92
		TIME SAMPLED:	1200
ATTN:	Mr. David Fulton	DATE RECEIVED:	10/02/92
		DATE REPORTED:	10/16/92
SAMPLE ID:	T-870-12-MW-U-92-HF	DISPOSAL DATE:	11/15/92
		ANALYSIS DATE:	10/12/92

ANALYSIS: Priority Pollutants by GCMS (Volatiles)
EPA Method SW-846 8240

COMPOUNDS	FINAL RESULTS	QUANTITATION LIMIT
Chloromethane	<10 ug/l	10 ug/l
Vinyl Chloride	<10 ug/l	10 ug/l
Bromomethane	<10 ug/l	10 ug/l
Chloroethane	<10 ug/l	10 ug/l
Trichlorofluoromethane	<5 ug/l	5 ug/l
Acrolein	<100 ug/l	100 ug/l
1,1-Dichloroethene	<5 ug/l	5 ug/l
Methylene Chloride	11 ug/l	5 ug/l
Acrylonitrile	<100 ug/l	100 ug/l
1,1-Dichloroethane	<5 ug/l	5 ug/l
1,2-Dichloroethene (total)	<5 ug/l	5 ug/l
Chloroform	<5 ug/l	5 ug/l
1,1,1-Trichloroethane	<5 ug/l	5 ug/l
Carbon Tetrachloride	<5 ug/l	5 ug/l
Benzene	10 ug/l	5 ug/l
1,2-Dichloroethane	<5 ug/l	5 ug/l
Trichloroethene	<5 ug/l	5 ug/l
1,2-Dichloropropane	<5 ug/l	5 ug/l
Bromodichloromethane	<5 ug/l	5 ug/l
2-Chloroethylvinyl ether	<10 ug/l	10 ug/l
cis-1,3-Dichloropropene	<5 ug/l	5 ug/l
Toluene	<5 ug/l	5 ug/l
trans-1,3-Dichloropropene	<5 ug/l	5 ug/l
1,1,2-Trichloroethane	<5 ug/l	5 ug/l
Tetrachloroethene	<5 ug/l	5 ug/l
Dibromochloromethane	<5 ug/l	5 ug/l
Chlorobenzene	<5 ug/l	5 ug/l
Ethylbenzene	29 ug/l	5 ug/l
Xylenes (Total)	300 ug/l	5 ug/l
Bromoform	<5 ug/l	5 ug/l
1,1,2,2-Tetrachloroethane	<5 ug/l	5 ug/l

OVER

Respectfully submitted,

John G. Hayes

John G. Hayes, B.S.
Supervisor, GCMS Group

Analytical Report

Mountain States Analytical

The Quality Solution

CLIENT:	J.M. Montgomery Engineers 4525 S. Wasatch #200 Salt Lake City, UT 84124	LAB NO:	34825
		GROUP NO:	8810
		DATE SAMPLED:	09/30/92
		TIME SAMPLED:	1325
ATTN:	Mr. David Fulton	DATE RECEIVED:	10/02/92
		DATE REPORTED:	10/14/92
SAMPLE ID:	T-870-11-MW-U-92-HF	DISPOSAL DATE:	11/13/92
		ANALYSIS DATE:	10/09/92

ANALYSIS: Priority Pollutants by GCMS (Volatiles)
EPA Method SW-846 8240

COMPOUNDS	FINAL RESULTS	QUANTITATION LIMIT
Chloromethane	<10 ug/l	10 ug/l
Vinyl Chloride	<10 ug/l	10 ug/l
Bromomethane	<10 ug/l	10 ug/l
Chloroethane	<10 ug/l	10 ug/l
Trichlorofluoromethane	<5 ug/l	5 ug/l
Acrolein	<100 ug/l	100 ug/l
1,1-Dichloroethene	<5 ug/l	5 ug/l
Methylene Chloride	<5 ug/l	5 ug/l
Acrylonitrile	<100 ug/l	100 ug/l
1,1-Dichloroethane	<5 ug/l	5 ug/l
1,2-Dichloroethene (total)	<5 ug/l	5 ug/l
Chloroform	<5 ug/l	5 ug/l
1,1,1-Trichloroethane	<5 ug/l	5 ug/l
Carbon Tetrachloride	<5 ug/l	5 ug/l
Benzene	26 ug/l	5 ug/l
1,2-Dichloroethane	<5 ug/l	5 ug/l
Trichloroethene	<5 ug/l	5 ug/l
1,2-Dichloropropane	<5 ug/l	5 ug/l
Bromodichloromethane	<5 ug/l	5 ug/l
2-Chloroethylvinyl ether	<10 ug/l	10 ug/l
cis-1,3-Dichloropropene	<5 ug/l	5 ug/l
Toluene	33 ug/l	5 ug/l
trans-1,3-Dichloropropene	<5 ug/l	5 ug/l
1,1,2-Trichloroethane	<5 ug/l	5 ug/l
Tetrachloroethene	<5 ug/l	5 ug/l
Dibromochloromethane	<5 ug/l	5 ug/l
Chlorobenzene	<5 ug/l	5 ug/l
Ethylbenzene	21 ug/l	5 ug/l
Xylenes (Total)	180 ug/l	5 ug/l
Bromoform	<5 ug/l	5 ug/l
1,1,2,2-Tetrachloroethane	<5 ug/l	5 ug/l

Respectfully submitted,

John G. Hayes

John G. Hayes, B.S.
Supervisor, GCMS Group

1645 West 2200 South, Salt Lake City, Utah 84119 (801) 973-0050 FAX (801) 972-6278

Mountain States Analytical

The Quality Solution

CLIENT:	J.M. Montgomery Engineers	LAB NO:	34824
	4525 S. Wasatch #200	GROUP NO:	8810
	Salt Lake City, UT 84124	DATE SAMPLED:	09/30/92
		TIME SAMPLED:	1100
ATTN:	Mr. David Fulton	DATE RECEIVED:	10/02/92
		DATE REPORTED:	10/21/92
SAMPLE ID:	T-870-27-MW-U-92-HF	DISPOSAL DATE:	11/20/92
		ANALYSIS DATE:	10/09/92

ANALYSIS: Priority Pollutants by GCMS (Volatiles)
EPA Method SW-846 8240

COMPOUNDS	FINAL RESULTS	QUANTITATION LIMIT
Bromoform	<50 ug/l	50 ug/l
1,1,2,2-Tetrachloroethane	J 2 ug/l	5 ug/l

J - Estimated Value

Comment: Due to the sample matrix and level of target compounds, dilution was required. The limits of quantation were raised accordingly. The compounds which are reported with "J" values were taken from the original 5.0 ml analysis.

Respectfully submitted,

John G. Hayes, B.S.
Supervisor, GCMS Group

Analytical Report

Mountain States Analytical

The Quality Solution

CLIENT: J.M. Montgomery Engineers
4525 S. Wasatch #200
Salt Lake City, UT 84124

ATTN: Mr. David Fulton

SAMPLE ID: T-870-5-MW-U-92-HF

LAB NO: 34823
GROUP NO: 8810
DATE SAMPLED: 09/30/92
TIME SAMPLED: 1320
DATE RECEIVED: 10/02/92
DATE REPORTED: 10/21/92
DISPOSAL DATE: 11/20/92
ANALYSIS DATE: 10/09/92

ANALYSIS: Priority Pollutants by GCMS (Volatiles)
EPA Method SW-846 8240

COMPOUNDS	FINAL RESULTS	QUANTITATION LIMIT
Chloromethane	J 4 ug/l	10 ug/l
Vinyl Chloride	<100 ug/l	100 ug/l
Bromomethane	<100 ug/l	100 ug/l
Chloroethane	<100 ug/l	100 ug/l
Trichlorofluoromethane	<50 ug/l	50 ug/l
Acrolein	<1,000 ug/l	1,000 ug/l
1,1-Dichloroethene	<50 ug/l	50 ug/l
Methylene Chloride	<50 ug/l	50 ug/l
Acrylonitrile	<1,000 ug/l	1,000 ug/l
1,1-Dichloroethane	<50 ug/l	50 ug/l
1,2-Dichloroethene (total)	<50 ug/l	50 ug/l
Chloroform	<50 ug/l	50 ug/l
1,1,1-Trichloroethane	<50 ug/l	50 ug/l
Carbon Tetrachloride	<50 ug/l	50 ug/l
Benzene	74 ug/l	50 ug/l
1,2-Dichloroethane	<50 ug/l	50 ug/l
Trichloroethene	<50 ug/l	50 ug/l
1,2-Dichloropropane	<50 ug/l	50 ug/l
Bromodichloromethane	<50 ug/l	50 ug/l
2-Chloroethylvinyl ether	<100 ug/l	100 ug/l
cis-1,3-Dichloropropene	<50 ug/l	50 ug/l
Toluene	<50 ug/l	50 ug/l
trans-1,3-Dichloropropene	<50 ug/l	50 ug/l
1,1,2-Trichloroethane	<50 ug/l	50 ug/l
Tetrachloroethene	J 2 ug/l	5 ug/l
Dibromochloromethane	<50 ug/l	50 ug/l
Chlorobenzene	<50 ug/l	50 ug/l
Ethylbenzene	160 ug/l	50 ug/l
Xylenes (Total)	900 ug/l	50 ug/l

J - Estimated Value

-Continued-

1645 West 2200 South, Salt Lake City, Utah 84119 (801) 973-0050 FAX (801) 972-6278

Mountain States Analytical
The Quality Solution

CLIENT:	J.M. Montgomery Engineers 4525 S. Wasatch #200 Salt Lake City, UT 84124	LAB NO:	34822
		GROUP NO:	8810
		DATE SAMPLED:	09/30/92
		TIME SAMPLED:	1000
ATTN:	Mr. David Fulton	DATE RECEIVED:	10/02/92
		DATE REPORTED:	10/21/92
SAMPLE ID:	CPT-7	DISPOSAL DATE:	11/20/92
		ANALYSIS DATE:	10/09/92

ANALYSIS: Priority Pollutants by GCMS (Volatiles)
EPA Method SW-846 8240

COMPOUNDS	FINAL RESULTS	QUANTITATION LIMIT
Bromoform	<250 ug/l	250 ug/l
1,1,2,2-Tetrachloroethane	* <50 ug/l	50 ug/l

Comment: Due to the sample matrix and level of target compounds, dilution was required. The limits of quantitation were raised accordingly. In an attempt to acheive lower detection limits for Tetrachloroethene, the sample was rerun at lower dilutions. A 5.0 ml portion could not be performed due to the excessive signal. A 1.0 ml aliquot was performed and Tetrachloroethene was not detected. The "*" compounds are from the 1.0 ml analysis. The 1.0 ml analysis was performed outside of holding time.

Respectfully submitted,

John G. Hayes

John G. Hayes, B.S.
Supervisor, GCMS Group

Mountain States Analytical
The Quality Solution

dup of MW-7 (MW-D)

CLIENT:	J.M. Montgomery Engineers 4525 S. Wasatch #200 Salt Lake City, UT 84124	LAB NO: GROUP NO: DATE SAMPLED: TIME SAMPLED:	34824 8810 09/30/92 1100
ATTN:	Mr. David Fulton	DATE RECEIVED: DATE REPORTED:	10/02/92 10/21/92
SAMPLE ID:	T-870-27-MW-U-92-HF	DISPOSAL DATE: ANALYSIS DATE:	11/20/92 10/09/92

ANALYSIS: Priority Pollutants by GCMS (Volatiles) — Noted as Duplicate
EPA Method SW-846 8240

COMPOUNDS	FINAL RESULTS	QUANTITATION LIMIT
Chloromethane	<100 ug/l	100 ug/l
Vinyl Chloride	<100 ug/l	100 ug/l
Bromomethane	<100 ug/l	100 ug/l
Chloroethane	<100 ug/l	100 ug/l
Trichlorofluoromethane	<50 ug/l	50 ug/l
Acrolein	<1,000 ug/l	1,000 ug/l
1,1-Dichloroethene	<50 ug/l	50 ug/l
Methylene Chloride	<50 ug/l	50 ug/l
Acrylonitrile	<1,000 ug/l	1,000 ug/l
1,1-Dichloroethane	<50 ug/l	50 ug/l
1,2-Dichloroethene (total)	<50 ug/l	50 ug/l
Chloroform	<50 ug/l	50 ug/l
1,1,1-Trichloroethane	<50 ug/l	50 ug/l
Carbon Tetrachloride	<50 ug/l	50 ug/l
Benzene	76 ug/l	50 ug/l
1,2-Dichloroethane	<50 ug/l	50 ug/l
Trichloroethene	8 ug/l	5 ug/l
1,2-Dichloropropane	<50 ug/l	50 ug/l
Bromodichloromethane	<50 ug/l	50 ug/l
2-Chloroethylvinyl ether	<100 ug/l	100 ug/l
cis-1,3-Dichloropropene	<50 ug/l	50 ug/l
Toluene	<50 ug/l	50 ug/l
trans-1,3-Dichloropropene	<50 ug/l	50 ug/l
1,1,2-Trichloroethane	<50 ug/l	50 ug/l
Tetrachloroethene	J 3 ug/l	5 ug/l
Dibromochloromethane	<50 ug/l	50 ug/l
Chlorobenzene	<50 ug/l	50 ug/l
Ethylbenzene	150 ug/l	50 ug/l
Xylenes (Total)	890 ug/l	50 ug/l

J - Estimated Value

-Continued-

Analytical Report

Mountain States Analytical

The Quality Solution

CLIENT: J.M. Montgomery Engineers
4525 S. Wasatch #200
Salt Lake City, UT 84124

ATTN: Mr. David Fulton

SAMPLE ID: T-870-5-MW-U-92-HF

LAB NO: 34823
GROUP NO: 8810
DATE SAMPLED: 09/30/92
TIME SAMPLED: 1320
DATE RECEIVED: 10/02/92
DATE REPORTED: 10/21/92
DISPOSAL DATE: 11/20/92
ANALYSIS DATE: 10/09/92

ANALYSIS: Priority Pollutants by GCMS (Volatiles)
EPA Method SW-846 8240

COMPOUNDS	FINAL RESULTS	QUANTITATION LIMIT
Bromoform	<50 ug/l	50 ug/l
1,1,2,2-Tetrachloroethane	<50 ug/l	50 ug/l

Comment: Due to the matrix and level of target compounds in the sample, dilution was required. The limits of quantation were raised accordingly. The compounds which are reported with "J" values were taken from the original 5.0 ml analysis.

Respectfully submitted,

John G. Hayes

John G. Hayes, B.S.
Supervisor, GCMS Group

1645 West 2200 South, Salt Lake City, Utah 84119 (801) 973-0050 FAX (801) 972-6278

Mountain States Analytical
The Quality Solution

CLIENT: J.M. Montgomery Engineers
4525 S Wasatch #200
Salt Lake City, UT 84124

ATTN: Mr. Bob Glascok

SAMPLE ID: T-870-MW-6-U-92-HF

LAB NO: 31657
GROUP NO: 7730
DATE SAMPLED: 09/04/92
TIME SAMPLED: 1105
DATE RECEIVED: 09/04/92
DATE REPORTED: 09/30/92
DISPOSAL DATE: 10/31/92
ANALYSIS DATE: 09/14/92

ANALYSIS: TCL VOLATILES (SOW - 2/88)

COMPOUNDS	FINAL RESULTS	QUANTITATION LIMIT
Chloromethane	<50 ug/l	50 ug/l
Vinyl Chloride	<50 ug/l	50 ug/l
Bromomethane	<50 ug/l	50 ug/l
Chloroethane	<50 ug/l	50 ug/l
1,1-Dichloroethene	<25 ug/l	25 ug/l
Acetone	<100 ug/l	100 ug/l
Carbon Disulfide	<25 ug/l	25 ug/l
Methylene Chloride	<25 ug/l	25 ug/l
1,1-Dichloroethane	<25 ug/l	25 ug/l
Vinyl Acetate	<25 ug/l	25 ug/l
2-Butanone	<100 ug/l	100 ug/l
1,2-Dichloroethene (total)	<25 ug/l	25 ug/l
Chloroform	<25 ug/l	25 ug/l
1,1,1-Trichloroethane	<25 ug/l	25 ug/l
Carbon Tetrachloride	<25 ug/l	25 ug/l
Benzene	<25 ug/l	25 ug/l
1,2-Dichloroethane	<25 ug/l	25 ug/l
Trichloroethene	<25 ug/l	25 ug/l
1,2-Dichloropropane	<25 ug/l	25 ug/l
Bromodichloromethane	<25 ug/l	25 ug/l
cis-1,3-Dichloropropene	<25 ug/l	25 ug/l
4-Methyl-2-Pentanone	<50 ug/l	50 ug/l
Toluene	<25 ug/l	25 ug/l
trans-1,3-Dichloropropene	<25 ug/l	25 ug/l
1,1,2-Trichloroethane	<25 ug/l	25 ug/l
Tetrachloroethene	<25 ug/l	25 ug/l
2-Hexanone	<50 ug/l	50 ug/l
Dibromochloromethane	<25 ug/l	25 ug/l
Chlorobenzene	<25 ug/l	25 ug/l
Ethylbenzene	<25 ug/l	25 ug/l
Xylenes (total)	<25 ug/l	25 ug/l
Styrene	<25 ug/l	25 ug/l

-Continued-

1645 West 2200 South, Salt Lake City, Utah 84119 (801) 973-0050 FAX (801) 972-6278

Analytical Report

Mountain States Analytical

The Quality Solution

CLIENT: J.M. Montgomery Engineers
4525 S Wasatch #200
Salt Lake City, UT 84124

ATTN: Mr. Bob Glascok

SAMPLE ID: T-870-MW-6-U-92-HF

LAB NO: 31657
GROUP NO: 7730
DATE SAMPLED: 06/04/92
TIME SAMPLED: 1105
DATE RECEIVED: 06/04/92
DATE REPORTED: 09/30/92
DISPOSAL DATE: 10/31/92
ANALYSIS DATE: 06/13/92

ANALYSIS: TCL VOLATILES

COMPOUNDS	FINAL RESULTS	QUANTITATION LIMIT
Bromoform	<25 ug/l	25 ug/l
1,1,2,2-Tetrachloroethane	<25 ug/l	25 ug/l

Comment: Due to the sample matrix, dilution was required. Limits of quantitation were raised accordingly.

Respectfully submitted,

John G Hayes

John G Hayes, B.S.
Supervisor, GCMS Group

1645 West 2200 South, Salt Lake City, Utah 84119 (801) 973-0050 FAX (801) 972-6278

Analytical Report

Mountain States Analytical

The Quality Solution

CLIENT: J.M. Montgomery Engineers
4525 S Wasatch #200
Salt Lake City, UT 84124

ATTN: Mr. Robert Glascok

SAMPLE ID: T-870-MW-7-U-92-HF

LAB NO: 31786
GROUP NO: 7776
DATE SAMPLED: 09/07/92
TIME SAMPLED: 1440
DATE RECEIVED: 09/08/92
DATE REPORTED: 09/16/92
DISPOSAL DATE: 10/17/92
ANALYSIS DATE: 09/15/92

ANALYSIS: TCL VOLATILES (SOW - 2/88)

COMPOUNDS	FINAL RESULTS	QUANTITATION LIMIT
Chloromethane	<10 ug/l	10 ug/l
Vinyl Chloride	<10 ug/l	10 ug/l
Bromomethane	<10 ug/l	10 ug/l
Chloroethane	<10 ug/l	10 ug/l
1,1-Dichloroethene	<5 ug/l	5 ug/l
Acetone	<20 ug/l	20 ug/l
Carbon Disulfide	<5 ug/l	5 ug/l
Methylene Chloride	<5 ug/l	5 ug/l
1,1-Dichloroethane	<5 ug/l	5 ug/l
Vinyl Acetate	<5 ug/l	5 ug/l
2-Butanone	<20 ug/l	20 ug/l
1,2-Dichloroethene (total)	<5 ug/l	5 ug/l
Chloroform	<5 ug/l	5 ug/l
1,1,1-Trichloroethane	<5 ug/l	5 ug/l
Carbon Tetrachloride	<5 ug/l	5 ug/l
Benzene	<5 ug/l	5 ug/l
1,2-Dichloroethane	<5 ug/l	5 ug/l
Trichloroethene	<5 ug/l	5 ug/l
1,2-Dichloropropane	<5 ug/l	5 ug/l
Bromodichloromethane	<5 ug/l	5 ug/l
cis-1,3-Dichloropropene	<5 ug/l	5 ug/l
4-Methyl-2-Pentanone	<10 ug/l	10 ug/l
Toluene	<5 ug/l	5 ug/l
trans-1,3-Dichloropropene	<5 ug/l	5 ug/l
1,1,2-Trichloroethane	<5 ug/l	5 ug/l
Tetrachloroethene	<5 ug/l	5 ug/l
2-Hexanone	<10 ug/l	10 ug/l
Dibromochloromethane	<5 ug/l	5 ug/l
Chlorobenzene	<5 ug/l	5 ug/l
Ethylbenzene	<5 ug/l	5 ug/l
Xylenes (total)	<5 ug/l	5 ug/l
Styrene	<5 ug/l	5 ug/l

-Continued-

Analytical Report

Mountain States Analytical
The Quality Solution

CLIENT:	J.M. Montgomery Engineers 4525 S Wasatch #200 Salt Lake City, UT 84124	LAB NO:	31786
		GROUP NO:	7776
		DATE SAMPLED:	06/04/92
		TIME SAMPLED:	1440
ATTN:	Mr. Robert Glascok	DATE RECEIVED:	06/04/92
		DATE REPORTED:	09/16/92
SAMPLE ID:	T-870-MW-7-U-92-HF	DISPOSAL DATE:	10/17/92
		ANALYSIS DATE:	06/13/92

ANALYSIS: TCL VOLATILES

COMPOUNDS	FINAL RESULTS	QUANTITATION LIMIT
Bromoform	<5 ug/l	5 ug/l
1,1,2,2-Tetrachloroethane	<5 ug/l	5 ug/l

Respectfully submitted,

John G Hayes

John G Hayes, B.S.
Supervisor, GCMS Group

Analytical Report

Mountain States Analytical
The Quality Solution

dup of MW-7 ?

CLIENT:	J.M. Montgomery Engineers 4525 S Wasatch #200 Salt Lake City, UT 84124	LAB NO:	31781
		GROUP NO:	7776
		DATE SAMPLED:	09/07/92
		TIME SAMPLED:	900
ATTN:	Mr. Robert Glascok	DATE RECEIVED:	09/08/92
		DATE REPORTED:	09/16/92
SAMPLE ID:	T-870-MW-27-U-92-HF	DISPOSAL DATE:	10/17/92
		ANALYSIS DATE:	09/15/92

ANALYSIS: TCL VOLATILES (SOW - 2/88)

COMPOUNDS	FINAL RESULTS	QUANTITATION LIMIT
Chloromethane	<10 ug/l	10 ug/l
Vinyl Chloride	<10 ug/l	10 ug/l
Bromomethane	<10 ug/l	10 ug/l
Chloroethane	<10 ug/l	10 ug/l
1,1-Dichloroethene	<5 ug/l	5 ug/l
Acetone	<20 ug/l	20 ug/l
Carbon Disulfide	<5 ug/l	5 ug/l
Methylene Chloride	<5 ug/l	5 ug/l
1,1-Dichloroethane	<5 ug/l	5 ug/l
Vinyl Acetate	<5 ug/l	5 ug/l
2-Butanone	<20 ug/l	20 ug/l
1,2-Dichloroethene (total)	<5 ug/l	5 ug/l
Chloroform	<5 ug/l	5 ug/l
1,1,1-Trichloroethane	<5 ug/l	5 ug/l
Carbon Tetrachloride	<5 ug/l	5 ug/l
Benzene	<5 ug/l	5 ug/l
1,2-Dichloroethane	<5 ug/l	5 ug/l
Trichloroethene	<5 ug/l	5 ug/l
1,2-Dichloropropane	<5 ug/l	5 ug/l
Bromodichloromethane	<5 ug/l	5 ug/l
cis-1,3-Dichloropropene	<5 ug/l	5 ug/l
4-Methyl-2-Pentanone	<10 ug/l	10 ug/l
Toluene	<5 ug/l	5 ug/l
trans-1,3-Dichloropropene	<5 ug/l	5 ug/l
1,1,2-Trichloroethane	<5 ug/l	5 ug/l
Tetrachloroethene	<5 ug/l	5 ug/l
2-Hexanone	<10 ug/l	10 ug/l
Dibromochloromethane	<5 ug/l	5 ug/l
Chlorobenzene	<5 ug/l	5 ug/l
Ethylbenzene	<5 ug/l	5 ug/l
Xylenes (total)	<5 ug/l	5 ug/l
Styrene	<5 ug/l	5 ug/l

-Continued-

Analytical Report

Mountain States Analytical

The Quality Solution

CLIENT:	J.M. Montgomery Engineers 4525 S Wasatch #200 Salt Lake City, UT 84124	LAB NO:	31781
		GROUP NO:	7776
		DATE SAMPLED:	06/04/92
		TIME SAMPLED:	900
ATTN:	Mr. Robert Glascok	DATE RECEIVED:	06/04/92
		DATE REPORTED:	09/16/92
SAMPLE ID:	T-870-MW-27-U-92-HF	DISPOSAL DATE:	10/17/92
		ANALYSIS DATE:	06/13/92

ANALYSIS: TCL VOLATILES

COMPOUNDS	FINAL RESULTS	QUANTITATION LIMIT
Bromoform	<5 ug/l	5 ug/l
1,1,2,2-Tetrachloroethane	<5 ug/l	5 ug/l

Respectfully submitted,

John G Hayes

John G Hayes, B.S.
Supervisor, GCMS Group

1645 West 2200 South, Salt Lake City, Utah 84119 (801) 973-0050 FAX (801) 972-6278

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT: James M. Montgomery
4525 S. Wasatch Blvd.
SLC, Utah 84124

SAMPLE SOURCE: TWP-01
(mw8)

PROJECT NO. : 92-1016
SAMPLE NO. : 122
REPORT DATE : 10/09/92
REVIEWED BY : RAK

Sample Analysis

Parameter	Result	Unit	Detection Level
cis 1,2-Dichloroethene	N/A	mg/L	0.005
trans 1,2-Dichloroethene ..	N/A	mg/L	0.005
1,2-Dichloropropane	N/A	mg/L	0.005
1,3-Dichloropropane	N/A	mg/L	0.005
2,2-Dichloropropane	N/A	mg/L	0.005
1,1-Dichloropropene	N/A	mg/L	0.005
1,1-Dichloroethene	N/A	mg/L	0.005
cis 1,3-Dichloropropene ...	N/A	mg/L	0.005
trans 1,3-Dichloropropene .	N/A	mg/L	0.005
Ethylbenzene	0.085	mg/L	0.005
Hexachlorobutadiene	N/A	mg/L	0.005
Isoproylbenzene	N/A	mg/L	0.005
4-Isopropyltoluene	N/A	mg/L	0.005
Dichloromethane	N/A	mg/L	0.005
Napthalene	N/A	mg/L	0.005
Propylbenzene	N/A	mg/L	0.005
Styrene	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethane .	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethene (Tetrachloroethylene)	0.795	mg/L	0.005
1,1,1,2-Tetrachloroethane .	N/A	mg/L	0.005
Toluene	1.271	mg/L	0.005
1,2,3-Trichlorobenzene	N/A	mg/L	0.005
1,2,4-Trichlorobenzene	N/A	mg/L	0.005
1,1,1-Trichloroethane	N/A	mg/L	0.005
1,1,2-Trichloroethane	N/A	mg/L	0.005
Trichloroethene (TCE)	N/A	mg/L	0.005
Fluorotrichloromethane	N/A	mg/L	0.005
1,2,3-Trichloropropane	N/A	mg/L	0.005
1,2,4-Trimethylbenzene	N/A	mg/L	0.005
1,3,5-Trimethylbenzene	N/A	mg/L	0.005
Vinyl chloride	N/A	mg/L	0.005
p-m-Xylene	0.141	mg/L	0.005
o-Xylene	0.032	mg/L	0.005

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT:	James M. Montgomery 4525 S. Wasatch Blvd. SLC, Utah 84124	PROJECT NO. : SAMPLE NO. : REPORT DATE : REVIEWED BY :	92-1016 122 10/09/92 RAK
	Attn: David A. Fulton	PAGE :	1 OF 2

CLIENT ID NO. :	None	AUTHORIZED BY :	DAF
SAMPLE MATRIX :	Ground Water	CLIENT P.O. :	None
SAMPLED BY :	JMM Personnel	SAMPLE DATE :	08/12/92
SAMPLE SOURCE :	TWP-01	SUBMITTAL DATE:	08/12/92
ANALYST :	NKT	ANALYSIS DATE :	08/12/92

Organic Monitoring-Drinking Water Volatiles
Full Suite

Sample Analysis

Parameter	Result	Unit	Detection Level
Benzene	0.520	mg/L	0.005
Bromobenzene	N/A	mg/L	0.005
Bromochloromethane	N/A	mg/L	0.005
Bromodichloromethane	N/A	mg/L	0.005
Bromoform	N/A	mg/L	0.005
Bromomethane	N/A	mg/L	0.005
n-Butylbenzene	N/A	mg/L	0.005
sec-Butylbenzene	N/A	mg/L	0.005
tert-Butylbenzene	N/A	mg/L	0.005
Carbon tetrachloride	N/A	mg/L	0.005
Chlorobenzene	N/A	mg/L	0.005
Chloroethane	N/A	mg/L	0.005
Chloroform	N/A	mg/L	0.005
Chloromethane	N/A	mg/L	0.005
2-Chlorotoluene (ortho) ...	N/A	mg/L	0.005
4-Chlorotoluene (para)	N/A	mg/L	0.005
1,2-Dibromoethane (EDB) ...	N/A	mg/L	0.005
1,2-Dibromo-3-chloropropane	N/A	mg/L	0.005
Dibromochloromethane	N/A	mg/L	0.005
Dibromomethane	N/A	mg/L	0.005
1,2-Dichlorobenzene (ortho)	N/A	mg/L	0.005
1,3-Dichlorobenzene (meta)	N/A	mg/L	0.005
1,4-Dichlorobenzene (para)	N/A	mg/L	0.005
Dichlorodifluoromethane ...	N/A	mg/L	0.005
1,1-Dichloroethane	N/A	mg/L	0.005
1,2-Dichloroethane	N/A	mg/L	0.005

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT:	James M. Montgomery	PROJECT NO. :	92-1016
	4525 S. Wasatch Blvd.	SAMPLE NO. :	16
	SLC, Utah 84124	REPORT DATE :	10/09/92
		REVIEWED BY :	RAK
	Attn: David A. Fulton	PAGE :	1 OF 2

CLIENT ID NO. :	None	AUTHORIZED BY :	DAF
SAMPLE MATRIX :	Soil Gas	CLIENT P.O. :	None
SAMPLED BY :	NKT/RAK	SAMPLE DATE :	08/05/92
SAMPLE SOURCE :	SGS-01	SUBMITTAL DATE:	08/05/92
ALYST :	NKT	ANALYSIS DATE :	08/05/92

Organic Monitoring-Drinking Water Volatiles
Full Suite

Sample Analysis			
Parameter	Result	Unit	Detection Level
Benzene	0.161	mg/L	0.005
Bromobenzene	N/A	mg/L	0.005
Bromochloromethane	N/A	mg/L	0.005
Bromodichloromethane	N/A	mg/L	0.005
Bromoform	N/A	mg/L	0.005
Bromomethane	N/A	mg/L	0.005
n-Butylbenzene	N/A	mg/L	0.005
sec-Butylbenzene	N/A	mg/L	0.005
tert-Butylbenzene	N/A	mg/L	0.005
Carbon tetrachloride	N/A	mg/L	0.005
Chlorobenzene	N/A	mg/L	0.005
Chloroethane	N/A	mg/L	0.005
Chloroform	N/A	mg/L	0.005
Chloromethane	N/A	mg/L	0.005
2-Chlorotoluene (ortho) ...	N/A	mg/L	0.005
4-Chlorotoluene (para)	N/A	mg/L	0.005
1,2-Dibromoethane (EDB) ...	N/A	mg/L	0.005
1,2-Dibromo-3-chloropropane	N/A	mg/L	0.005
Dibromochloromethane	N/A	mg/L	0.005
Dibromomethane	N/A	mg/L	0.005
1,2-Dichlorobenzene (ortho)	N/A	mg/L	0.005
1,3-Dichlorobenzene (meta)	N/A	mg/L	0.005
1,4-Dichlorobenzene (para)	N/A	mg/L	0.005
Dichlorodifluoromethane ...	N/A	mg/L	0.005
1,1-Dichloroethane	N/A	mg/L	0.005
1,2-Dichloroethane	N/A	mg/L	0.005

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT: James M. Montgomery
4525 S. Wasatch Blvd.
SLC, Utah 84124

SAMPLE SOURCE: SGS-01

PROJECT NO. : 92-1016
SAMPLE NO. : 16
REPORT DATE : 10/09/92
REVIEWED BY : RAK

Sample Analysis

Parameter	Result	Unit	Detection Level
cis 1,2-Dichloroethene	N/A	mg/L	0.005
trans 1,2-Dichloroethene ..	N/A	mg/L	0.005
1,2-Dichloropropane	N/A	mg/L	0.005
1,3-Dichloropropane	N/A	mg/L	0.005
2,2-Dichloropropane	N/A	mg/L	0.005
1,1-Dichloropropene	N/A	mg/L	0.005
1,1-Dichloroethene	N/A	mg/L	0.005
cis 1,3-Dichloropropene ...	N/A	mg/L	0.005
trans 1,3-Dichloropropene .	N/A	mg/L	0.005
Ethylbenzene	0.046	mg/L	0.005
Hexachlorobutadiene	N/A	mg/L	0.005
Isoproylbenzene	N/A	mg/L	0.005
4-Isopropyltoluene	N/A	mg/L	0.005
Dichloromethane	N/A	mg/L	0.005
Napthalene	N/A	mg/L	0.005
Propylbenzene	N/A	mg/L	0.005
Styrene	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethane .	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethene (Tetrachloroethylene)	< 0.005	mg/L	0.005
1,1,1,2-Tetrachloroethane .	N/A	mg/L	0.005
Toluene	12.645	mg/L	0.005
1,2,3-Trichlorobenzene	N/A	mg/L	0.005
1,2,4-Trichlorobenzene	N/A	mg/L	0.005
1,1,1-Trichloroethane	N/A	mg/L	0.005
1,1,2-Trichloroethane	N/A	mg/L	0.005
Trichloroethene (TCE)	N/A	mg/L	0.005
Fluorotrichloromethane	N/A	mg/L	0.005
1,2,3-Trichloropropane	N/A	mg/L	0.005
1,2,4-Trimethylbenzene	N/A	mg/L	0.005
1,3,5-Trimethylbenzene	N/A	mg/L	0.005
Vinyl chloride	N/A	mg/L	0.005
p-m-Xylene	< 0.005	mg/L	0.005
o-Xylene	0.295	mg/L	0.005

MONTGOMERY LABORATORIES
555 East Walnut Street, P.O. Box 7009
Pasadena, California 91109-7009
(818) 796-9141

Laboratory Report

Hill Air Force Base/JMM-SLC
4525 Wasatch Blvd

Salt Lake City , UT 84214
ATTN: Dave Fulton

Sample # 920810002 Sample ID SGS-1 Project VOA
Sample Type Water Sampled 07-aug-1992 Received 08-aug-1992 Reported 14-aug-1992

Volatile Organics HSL (ML/SW 8240)

Parameter	Units	Result	%Rec Conc.	Dilution	Det.Limit	Prepared	By	Analyzed	By
1,1,2-Trichloroethane (1,1,2-T	ug/l	ND		10	5			12-aug-1992	dfi
1,1-Dichloroethylene (1,1DCE)	ug/l	ND		10	5			12-aug-1992	dfi
1,1-Dichloroethane	ug/l	ND		10	5			12-aug-1992	dfi
1,2-Dichlorobenzene	ug/l	ND		10	5			12-aug-1992	dfi
1,2-Dichloroethane	ug/l	ND		10	5			12-aug-1992	dfi
1,2-Dichloropropane	ug/l	ND		10	5			12-aug-1992	dfi
1,3-Dichlorobenzene	ug/l	ND		10	5			12-aug-1992	dfi
1,4-Dichlorobenzene (p-DCB)	ug/l	ND		10	5			12-aug-1992	dfi
2-Butanone (MEK)	ug/l	ND		10	100			12-aug-1992	dfi
2-Chloroethylvinylether	ug/l	ND		10	10			12-aug-1992	dfi
2-Hexanone	ug/l	ND		10	100			12-aug-1992	dfi
4-Methyl-2-Pentanone (MIBK)	ug/l	ND		10	10			12-aug-1992	dfi
Acetone	ug/l	ND		10	100			12-aug-1992	dfi
Acrolein	ug/l	ND		10	10			12-aug-1992	dfi
Acrylonitrile	ug/l	ND		10	10			12-aug-1992	dfi
Benzene	ug/l	7.7		10	5			12-aug-1992	dfi
cis-1,2-Dichloroethene	ug/l	ND		10	5			12-aug-1992	dfi
Chlorobenzene	ug/l	ND		10	5			12-aug-1992	dfi
cis-1,3-Dichloropropene	ug/l	ND		10	5			12-aug-1992	dfi
Bromoform	ug/l	ND		10	5			12-aug-1992	dfi
Chloroform (Trichloromethane)	ug/l	ND		10	5			12-aug-1992	dfi
Chloroethane	ug/l	ND		10	10			12-aug-1992	dfi
Carbon disulfide	ug/l	ND		10	5			12-aug-1992	dfi
Carbon Tetrachloride	ug/l	ND		10	5			12-aug-1992	dfi
Dibromochloromethane	ug/l	ND		10	5			12-aug-1992	dfi
Dichlorobromomethane	ug/l	ND		10	5			12-aug-1992	dfi
Ethyl benzene	ug/l	5.5		10	5			12-aug-1992	dfi
Methyl Bromide	ug/l	ND		10	10			12-aug-1992	dfi
Methyl Chloride	ug/l	ND		10	10			12-aug-1992	dfi

Report #: 2253

MONTGOMERY LABORATORIES
555 East Walnut Street, P.O. Box 7009
Pasadena, California 91109-7009
(818) 796-9141

Laboratory Report

Hill Air Force Base/JMM-SLC
4525 Wasatch Blvd

Salt Lake City , UT 84214
ATTN: Dave Fulton

Sample # 920810002 Sample ID SGS-1 Project VOA
Sample Type Water Sampled 07-aug-1992 Received 08-aug-1992 Reported 14-aug-1992

Volatile Organics HSL (ML/SW 8240)

Parameter	Units	Result	%Rec Conc.	Dilution	Det.Limit	Prepared	By	Analyzed	By
Methylene Chloride	ug/l	ND		10	30			12-aug-1992	dfi
m,p-Xylenes	ug/l	8.8		10	5			12-aug-1992	dfi
o-Xylene	ug/l	19		10	5			12-aug-1992	dfi
1,1,2,2-Tetrachloroethane	ug/l	ND		10	5			12-aug-1992	dfi
Tetrachloroethylene (PCE)	ug/l	18		10	5			12-aug-1992	dfi
Styrene	ug/l	ND		10	5			12-aug-1992	dfi
trans-1,2-Dichloroethene	ug/l	ND		10	5			12-aug-1992	dfi
1,1,1-Trichloroethane	ug/l	ND		10	5			12-aug-1992	dfi
Trichloroethylene (TCE)	ug/l	ND		10	5			12-aug-1992	dfi
Trichlorofluoromethane	ug/l	ND		10	10			12-aug-1992	dfi
trans-1,3-Dichloropropene	ug/l	ND		10	5			12-aug-1992	dfi
Tetrahydrofuran	ug/l	ND		10	100			12-aug-1992	dfi
Toluene	ug/l	ND		10	5			12-aug-1992	dfi
Vinyl Chloride (VC)	ug/l	ND		10	10			12-aug-1992	dfi
Vinyl Acetate	ug/l	ND		10	100			12-aug-1992	dfi

Report #: 2253

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT:	James M. Montgomery 4525 S. Wasatch Blvd. SLC, Utah 84124	PROJECT NO. :	92-1016
		SAMPLE NO. :	57
		REPORT DATE :	10/09/92
		REVIEWED BY :	RAK
	Attn: David A. Fulton	PAGE :	1 OF 2

CLIENT ID NO. :	None	AUTHORIZED BY :	DAF
SAMPLE MATRIX :	Ground Water	CLIENT P.O. :	None
SAMPLED BY :	NKT/RAK	SAMPLE DATE :	08/05/92
SAMPLE SOURCE :	TP-01	SUBMITTAL DATE:	08/07/92
ANALYST :	NKT	ANALYSIS DATE :	08/07/92

Organic Monitoring-Drinking Water Volatiles
Full Suite

Sample Analysis

Parameter	Result	Unit	Detection Level
Benzene	0.741	mg/L	0.005
Bromobenzene	N/A	mg/L	0.005
Bromochloromethane	N/A	mg/L	0.005
Bromodichloromethane	N/A	mg/L	0.005
Bromoform	N/A	mg/L	0.005
Bromomethane	N/A	mg/L	0.005
n-Butylbenzene	N/A	mg/L	0.005
sec-Butylbenzene	N/A	mg/L	0.005
tert-Butylbenzene	N/A	mg/L	0.005
Carbon tetrachloride	N/A	mg/L	0.005
Chlorobenzene	N/A	mg/L	0.005
Chloroethane	N/A	mg/L	0.005
Chloroform	N/A	mg/L	0.005
Chloromethane	N/A	mg/L	0.005
2-Chlorotoluene (ortho) ...	N/A	mg/L	0.005
4-Chlorotoluene (para)	N/A	mg/L	0.005
1,2-Dibromoethane (EDB) ...	N/A	mg/L	0.005
1,2-Dibromo-3-chloropropane	N/A	mg/L	0.005
Dibromochloromethane	N/A	mg/L	0.005
Dibromomethane	N/A	mg/L	0.005
1,2-Dichlorobenzene (ortho)	N/A	mg/L	0.005
1,3-Dichlorobenzene (meta)	N/A	mg/L	0.005
1,4-Dichlorobenzene (para)	N/A	mg/L	0.005
Dichlorodifluoromethane ...	N/A	mg/L	0.005
1,1-Dichloroethane	N/A	mg/L	0.005
1,2-Dichloroethane	N/A	mg/L	0.005

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT:	James M. Montgomery 4525 S. Wasatch Blvd. SLC, Utah 84124	PROJECT NO. : SAMPLE NO. : REPORT DATE : REVIEWED BY :	92-1016 57 10/09/92 RAK
	SAMPLE SOURCE: TP-01	PAGE :	2 OF 2

Sample Analysis

Parameter	Result	Unit	Detection Level
cis 1,2-Dichloroethene	N/A	mg/L	0.005
trans 1,2-Dichloroethene ..	N/A	mg/L	0.005
1,2-Dichloropropane	N/A	mg/L	0.005
1,3-Dichloropropane	N/A	mg/L	0.005
2,2-Dichloropropane	N/A	mg/L	0.005
1,1-Dichloropropene	N/A	mg/L	0.005
1,1-Dichloroethene	N/A	mg/L	0.005
cis 1,3-Dichloropropene ...	N/A	mg/L	0.005
trans 1,3-Dichloropropene .	N/A	mg/L	0.005
Ethylbenzene	< 0.005	mg/L	0.005
Hexachlorobutadiene	N/A	mg/L	0.005
Isoproylbenzene	N/A	mg/L	0.005
4-Isopropyltoluene	N/A	mg/L	0.005
Dichloromethane	N/A	mg/L	0.005
Napthalene	N/A	mg/L	0.005
Propylbenzene	N/A	mg/L	0.005
Styrene	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethane .	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethene (Tetrachloroethylene)	0.425	mg/L	0.005
1,1,1,2-Tetrachloroethane .	N/A	mg/L	0.005
Toluene	2.273	mg/L	0.005
1,2,3-Trichlorobenzene	N/A	mg/L	0.005
1,2,4-Trichlorobenzene	N/A	mg/L	0.005
1,1,1-Trichloroethane	N/A	mg/L	0.005
1,1,2-Trichloroethane	N/A	mg/L	0.005
Trichloroethene (TCE)	N/A	mg/L	0.005
Fluorotrichloromethane	N/A	mg/L	0.005
1,2,3-Trichloropropane	N/A	mg/L	0.005
1,2,4-Trimethylbenzene	N/A	mg/L	0.005
1,3,5-Trimethylbenzene	N/A	mg/L	0.005
Vinyl chloride	N/A	mg/L	0.005
p-m-Xylene	0.540	mg/L	0.005
o-Xylene	0.487	mg/L	0.005

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT: James M. Montgomery
4525 S. Wasatch Blvd.
SLC, Utah 84124

SAMPLE SOURCE: TP-02

PROJECT NO. : 92-1016
SAMPLE NO. : 39
REPORT DATE : 10/09/92
REVIEWED BY : RAK
PAGE : 2 OF 2

Sample Analysis			
Parameter	Result	Unit	Detection Level
cis 1,2-Dichloroethene	N/A	mg/L	0.005
trans 1,2-Dichloroethene ..	N/A	mg/L	0.005
1,2-Dichloropropane	N/A	mg/L	0.005
1,3-Dichloropropane	N/A	mg/L	0.005
2,2-Dichloropropane	N/A	mg/L	0.005
1,1-Dichloropropene	N/A	mg/L	0.005
1,1-Dichloroethene	N/A	mg/L	0.005
cis 1,3-Dichloropropene ...	N/A	mg/L	0.005
trans 1,3-Dichloropropene .	N/A	mg/L	0.005
Ethylbenzene	0.740	mg/L	0.005
Hexachlorobutadiene	N/A	mg/L	0.005
Isoproylbenzene	N/A	mg/L	0.005
4-Isopropyltoluene	N/A	mg/L	0.005
Dichloromethane	N/A	mg/L	0.005
Napthalene	N/A	mg/L	0.005
Propylbenzene	N/A	mg/L	0.005
Styrene	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethane .	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethene (Tetrachloroethylene)	3.809	mg/L	0.005
1,1,1,2-Tetrachloroethane .	N/A	mg/L	0.005
Toluene	7.578	mg/L	0.005
1,2,3-Trichlorobenzene	N/A	mg/L	0.005
1,2,4-Trichlorobenzene	N/A	mg/L	0.005
1,1,1-Trichloroethane	N/A	mg/L	0.005
1,1,2-Trichloroethane	N/A	mg/L	0.005
Trichloroethene (TCE)	N/A	mg/L	0.005
Fluorotrichloromethane	N/A	mg/L	0.005
1,2,3-Trichloropropane	N/A	mg/L	0.005
1,2,4-Trimethylbenzene	N/A	mg/L	0.005
1,3,5-Trimethylbenzene	N/A	mg/L	0.005
Vinyl chloride	N/A	mg/L	0.005
p-m-Xylene	1.903	mg/L	0.005
o-Xylene	2.274	mg/L	0.005

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT: James M. Montgomery
4525 S. Wasatch Blvd.
SLC, Utah 84124

Attn: David A. Fulton

PROJECT NO. : 92-1016
SAMPLE NO. : 39
REPORT DATE : 10/09/92
REVIEWED BY : RAK
PAGE : 1 OF 2

CLIENT ID NO. : None
SAMPLE MATRIX : Ground Water
SAMPLED BY : NKT/RAK
SAMPLE SOURCE : TP-02
ANALYST : NKT

AUTHORIZED BY : DAF
CLIENT P.O. : None
SAMPLE DATE : 08/05/92
SUBMITTAL DATE: 08/05/92
ANALYSIS DATE : 08/06/92

Organic Monitoring-Drinking Water Volatiles
Full Suite

Sample Analysis

Parameter	Result	Unit	Detection Level
Benzene	5.203	mg/L	0.005
Bromobenzene	N/A	mg/L	0.005
Bromochloromethane	N/A	mg/L	0.005
Bromodichloromethane	N/A	mg/L	0.005
Bromoform	N/A	mg/L	0.005
Bromomethane	N/A	mg/L	0.005
n-Butylbenzene	N/A	mg/L	0.005
sec-Butylbenzene	N/A	mg/L	0.005
tert-Butylbenzene	N/A	mg/L	0.005
Carbon tetrachloride	N/A	mg/L	0.005
Chlorobenzene	N/A	mg/L	0.005
Chloroethane	N/A	mg/L	0.005
Chloroform	N/A	mg/L	0.005
Chloromethane	N/A	mg/L	0.005
2-Chlorotoluene (ortho) ...	N/A	mg/L	0.005
4-Chlorotoluene (para)	N/A	mg/L	0.005
1,2-Dibromoethane (EDB) ...	N/A	mg/L	0.005
1,2-Dibromo-3-chloropropane	N/A	mg/L	0.005
Dibromochloromethane	N/A	mg/L	0.005
Dibromomethane	N/A	mg/L	0.005
1,2-Dichlorobenzene (ortho)	N/A	mg/L	0.005
1,3-Dichlorobenzene (meta)	N/A	mg/L	0.005
1,4-Dichlorobenzene (para)	N/A	mg/L	0.005
Dichlorodifluoromethane ...	N/A	mg/L	0.005
1,1-Dichloroethane	N/A	mg/L	0.005
1,2-Dichloroethane	N/A	mg/L	0.005

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT:	James M. Montgomery 4525 S. Wasatch Blvd. SLC, Utah 84124	PROJECT NO. :	92-1016
		SAMPLE NO. :	90
		REPORT DATE :	10/09/92
		REVIEWED BY :	RAK
	Attn: David A. Fulton	PAGE :	1 OF 2

CLIENT ID NO. :	None	AUTHORIZED BY :	DAF
SAMPLE MATRIX :	Ground Water	CLIENT P.O. :	None
SAMPLED BY :	NKT/RAK	SAMPLE DATE :	08/10/92
SAMPLE SOURCE :	TP-03	SUBMITTAL DATE:	08/10/92
ANALYST :	NKT	ANALYSIS DATE :	08/10/92

Organic Monitoring-Drinking Water Volatiles
Full Suite

Sample Analysis

Parameter	Result	Unit	Detection Level
Benzene	2.701	mg/L	0.005
Bromobenzene	N/A	mg/L	0.005
Bromochloromethane	N/A	mg/L	0.005
Bromodichloromethane	N/A	mg/L	0.005
Bromoform	N/A	mg/L	0.005
Bromomethane	N/A	mg/L	0.005
n-Butylbenzene	N/A	mg/L	0.005
sec-Butylbenzene	N/A	mg/L	0.005
tert-Butylbenzene	N/A	mg/L	0.005
Carbon tetrachloride	N/A	mg/L	0.005
Chlorobenzene	N/A	mg/L	0.005
Chloroethane	N/A	mg/L	0.005
Chloroform	N/A	mg/L	0.005
Chloromethane	N/A	mg/L	0.005
2-Chlorotoluene (ortho) ...	N/A	mg/L	0.005
4-Chlorotoluene (para)	N/A	mg/L	0.005
1,2-Dibromoethane (EDB) ...	N/A	mg/L	0.005
1,2-Dibromo-3-chloropropane	N/A	mg/L	0.005
Dibromochloromethane	N/A	mg/L	0.005
Dibromomethane	N/A	mg/L	0.005
1,2-Dichlorobenzene (ortho)	N/A	mg/L	0.005
1,3-Dichlorobenzene (meta)	N/A	mg/L	0.005
1,4-Dichlorobenzene (para)	N/A	mg/L	0.005
Dichlorodifluoromethane ...	N/A	mg/L	0.005
1,1-Dichloroethane	N/A	mg/L	0.005
1,2-Dichloroethane	N/A	mg/L	0.005

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT: James M. Montgomery
4525 S. Wasatch Blvd.
SLC, Utah 84124

SAMPLE SOURCE: TP-03

PROJECT NO. : 92-1016
SAMPLE NO. : 90
REPORT DATE : 10/09/92
REVIEWED BY : RAK
PAGE : 2 OF 2

Sample Analysis

Parameter	Result	Unit	Detection Level
cis 1,2-Dichloroethene	N/A	mg/L	0.005
trans 1,2-Dichloroethene ..	N/A	mg/L	0.005
1,2-Dichloropropane	N/A	mg/L	0.005
1,3-Dichloropropane	N/A	mg/L	0.005
2,2-Dichloropropane	N/A	mg/L	0.005
1,1-Dichloropropene	N/A	mg/L	0.005
1,1-Dichloroethene	N/A	mg/L	0.005
cis 1,3-Dichloropropene ...	N/A	mg/L	0.005
trans 1,3-Dichloropropene .	N/A	mg/L	0.005
Ethylbenzene	0.322	mg/L	0.005
Hexachlorobutadiene	N/A	mg/L	0.005
Isoproylbenzene	N/A	mg/L	0.005
4-Isopropyltoluene	N/A	mg/L	0.005
Dichloromethane	N/A	mg/L	0.005
Napthalene	N/A	mg/L	0.005
Propylbenzene	N/A	mg/L	0.005
Styrene	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethane .	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethene (Tetrachloroethylene)	2.447	mg/L	0.005
1,1,1,2-Tetrachloroethane .	N/A	mg/L	0.005
Toluene	3.112	mg/L	0.005
1,2,3-Trichlorobenzene	N/A	mg/L	0.005
1,2,4-Trichlorobenzene	N/A	mg/L	0.005
1,1,1-Trichloroethane	N/A	mg/L	0.005
1,1,2-Trichloroethane	N/A	mg/L	0.005
Trichloroethene (TCE)	N/A	mg/L	0.005
Fluorotrichloromethane	N/A	mg/L	0.005
1,2,3-Trichloropropane	N/A	mg/L	0.005
1,2,4-Trimethylbenzene	N/A	mg/L	0.005
1,3,5-Trimethylbenzene	N/A	mg/L	0.005
Vinyl chloride	N/A	mg/L	0.005
p-m-Xylene	0.801	mg/L	0.005
o-Xylene	0.854	mg/L	0.005

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT: James M. Montgomery
4525 S. Wasatch Blvd.
SLC, Utah 84124

Attn: David A. Fulton

PROJECT NO. : 92-1016
SAMPLE NO. : 26
REPORT DATE : 10/09/92
REVIEWED BY : RAK
PAGE : 1 OF 2

CLIENT ID NO. : None
SAMPLE MATRIX : Ground Water
SAMPLED BY : NKT/RAK
SAMPLE SOURCE : TP-07
ANALYST : NKT

AUTHORIZED BY : DAF
CLIENT P.O. : None
SAMPLE DATE : 08/05/92
SUBMITTAL DATE: 08/05/92
ANALYSIS DATE : 08/06/92

Organic Monitoring-Drinking Water Volatiles
Full Suite

Sample Analysis

Parameter	Result	Unit	Detection Level
Benzene	26.092	mg/L	0.005
Bromobenzene	N/A	mg/L	0.005
Bromochloromethane	N/A	mg/L	0.005
Bromodichloromethane	N/A	mg/L	0.005
Bromoform	N/A	mg/L	0.005
Bromomethane	N/A	mg/L	0.005
n-Butylbenzene	N/A	mg/L	0.005
sec-Butylbenzene	N/A	mg/L	0.005
tert-Butylbenzene	N/A	mg/L	0.005
Carbon tetrachloride	N/A	mg/L	0.005
Chlorobenzene	N/A	mg/L	0.005
Chloroethane	N/A	mg/L	0.005
Chloroform	N/A	mg/L	0.005
Chloromethane	N/A	mg/L	0.005
2-Chlorotoluene (ortho) ...	N/A	mg/L	0.005
4-Chlorotoluene (para)	N/A	mg/L	0.005
1,2-Dibromoethane (EDB) ...	N/A	mg/L	0.005
1,2-Dibromo-3-chloropropane	N/A	mg/L	0.005
Dibromochloromethane	N/A	mg/L	0.005
Dibromomethane	N/A	mg/L	0.005
1,2-Dichlorobenzene (ortho)	N/A	mg/L	0.005
1,3-Dichlorobenzene (meta)	N/A	mg/L	0.005
1,4-Dichlorobenzene (para)	N/A	mg/L	0.005
Dichlorodifluoromethane ...	N/A	mg/L	0.005
1,1-Dichloroethane	N/A	mg/L	0.005
1,2-Dichloroethane	N/A	mg/L	0.005

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT: James M. Montgomery
4525 S. Wasatch Blvd.
SLC, Utah 84124

SAMPLE SOURCE: TP-07

PROJECT NO. : 92-1016
SAMPLE NO. : 26
REPORT DATE : 10/09/92
REVIEWED BY : RAK
PAGE : 2 OF 2

Sample Analysis

Parameter	Result	Unit	Detection Level
cis 1,2-Dichloroethene	N/A	mg/L	0.005
trans 1,2-Dichloroethene ..	N/A	mg/L	0.005
1,2-Dichloropropane	N/A	mg/L	0.005
1,3-Dichloropropane	N/A	mg/L	0.005
2,2-Dichloropropane	N/A	mg/L	0.005
1,1-Dichloropropene	N/A	mg/L	0.005
1,1-Dichloroethene	N/A	mg/L	0.005
cis 1,3-Dichloropropene ...	N/A	mg/L	0.005
trans 1,3-Dichloropropene .	N/A	mg/L	0.005
Ethylbenzene	0.753	mg/L	0.005
Hexachlorobutadiene	N/A	mg/L	0.005
Isoproylbenzene	N/A	mg/L	0.005
4-Isopropyltoluene	N/A	mg/L	0.005
Dichloromethane	N/A	mg/L	0.005
Napthalene	N/A	mg/L	0.005
Propylbenzene	N/A	mg/L	0.005
Styrene	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethane .	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethene (Tetrachloroethylene)	2.204	mg/L	0.005
1,1,1,2-Tetrachloroethane .	N/A	mg/L	0.005
Toluene	21.919	mg/L	0.005
1,2,3-Trichlorobenzene	N/A	mg/L	0.005
1,2,4-Trichlorobenzene	N/A	mg/L	0.005
1,1,1-Trichloroethane	N/A	mg/L	0.005
1,1,2-Trichloroethane	N/A	mg/L	0.005
Trichloroethene (TCE)	N/A	mg/L	0.005
Fluorotrichloromethane	N/A	mg/L	0.005
1,2,3-Trichloropropane	N/A	mg/L	0.005
1,2,4-Trimethylbenzene	N/A	mg/L	0.005
1,3,5-Trimethylbenzene	N/A	mg/L	0.005
Vinyl chloride	N/A	mg/L	0.005
p-m-Xylene	1.459	mg/L	0.005
o-Xylene	2.447	mg/L	0.005

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT:	James M. Montgomery 4525 S. Wasatch Blvd. SLC, Utah 84124	PROJECT NO. :	92-1016
		SAMPLE NO. :	37
		REPORT DATE :	10/09/92
		REVIEWED BY :	RAK
	Attn: David A. Fulton	PAGE :	1 OF 2

CLIENT ID NO. :	None	AUTHORIZED BY :	DAF
SAMPLE MATRIX :	Ground Water	CLIENT P.O. :	None
SAMPLED BY :	NKT/RAK	SAMPLE DATE :	08/06/92
SAMPLE SOURCE :	TP-09	SUBMITTAL DATE:	08/06/92
ANALYST :	NKT	ANALYSIS DATE :	08/06/92

Organic Monitoring-Drinking Water Volatiles
Full Suite

Sample Analysis

Parameter	Result	Unit	Detection Level
Benzene	0.992	mg/L	0.005
Bromobenzene	N/A	mg/L	0.005
Bromochloromethane	N/A	mg/L	0.005
Bromodichloromethane	N/A	mg/L	0.005
Bromoform	N/A	mg/L	0.005
Bromomethane	N/A	mg/L	0.005
n-Butylbenzene	N/A	mg/L	0.005
sec-Butylbenzene	N/A	mg/L	0.005
tert-Butylbenzene	N/A	mg/L	0.005
Carbon tetrachloride	N/A	mg/L	0.005
Chlorobenzene	N/A	mg/L	0.005
Chloroethane	N/A	mg/L	0.005
Chloroform	N/A	mg/L	0.005
Chloromethane	N/A	mg/L	0.005
2-Chlorotoluene (ortho) ...	N/A	mg/L	0.005
4-Chlorotoluene (para)	N/A	mg/L	0.005
1,2-Dibromoethane (EDB) ...	N/A	mg/L	0.005
1,2-Dibromo-3-chloropropane	N/A	mg/L	0.005
Dibromochloromethane	N/A	mg/L	0.005
Dibromomethane	N/A	mg/L	0.005
1,2-Dichlorobenzene (ortho)	N/A	mg/L	0.005
1,3-Dichlorobenzene (meta)	N/A	mg/L	0.005
1,4-Dichlorobenzene (para)	N/A	mg/L	0.005
Dichlorodifluoromethane ...	N/A	mg/L	0.005
1,1-Dichloroethane	N/A	mg/L	0.005
1,2-Dichloroethane	N/A	mg/L	0.005

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT: James M. Montgomery
4525 S. Wasatch Blvd.
SLC, Utah 84124

SAMPLE SOURCE: TP-09

PROJECT NO. : 92-1016
SAMPLE NO. : 37
REPORT DATE : 10/09/92
REVIEWED BY : RAK

Sample Analysis

Parameter	Result	Unit	Detection Level
cis 1,2-Dichloroethene	N/A	mg/L	0.005
trans 1,2-Dichloroethene ..	N/A	mg/L	0.005
1,2-Dichloropropane	N/A	mg/L	0.005
1,3-Dichloropropane	N/A	mg/L	0.005
2,2-Dichloropropane	N/A	mg/L	0.005
1,1-Dichloropropene	N/A	mg/L	0.005
1,1-Dichloroethene	N/A	mg/L	0.005
cis 1,3-Dichloropropene ...	N/A	mg/L	0.005
trans 1,3-Dichloropropene .	N/A	mg/L	0.005
Ethylbenzene	0.173	mg/L	0.005
Hexachlorobutadiene	N/A	mg/L	0.005
Isoproylbenzene	N/A	mg/L	0.005
4-Isopropyltoluene	N/A	mg/L	0.005
Dichloromethane	N/A	mg/L	0.005
Napthalene	N/A	mg/L	0.005
Propylbenzene	N/A	mg/L	0.005
Styrene	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethane .	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethene (Tetrachloroethylene)	1.269	mg/L	0.005
1,1,1,2-Tetrachloroethane .	N/A	mg/L	0.005
Toluene	2.128	mg/L	0.005
1,2,3-Trichlorobenzene	N/A	mg/L	0.005
1,2,4-Trichlorobenzene	N/A	mg/L	0.005
1,1,1-Trichloroethane	N/A	mg/L	0.005
1,1,2-Trichloroethane	N/A	mg/L	0.005
Trichloroethene (TCE)	N/A	mg/L	0.005
Fluorotrichloromethane	N/A	mg/L	0.005
1,2,3-Trichloropropane	N/A	mg/L	0.005
1,2,4-Trimethylbenzene	N/A	mg/L	0.005
1,3,5-Trimethylbenzene	N/A	mg/L	0.005
Vinyl chloride	N/A	mg/L	0.005
p-m-Xylene	0.211	mg/L	0.005
o-Xylene	0.090	mg/L	0.005

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT:	James M. Montgomery 4525 S. Wasatch Blvd. SLC, Utah 84124 Attn: David A. Fulton	PROJECT NO. : SAMPLE NO. : REPORT DATE : REVIEWED BY : PAGE :	92-1016 38 10/09/92 RAK 1 OF 2

CLIENT ID NO. :	None	AUTHORIZED BY :	DAF
SAMPLE MATRIX :	Ground Water	CLIENT P.O. :	None
SAMPLED BY :	NKT/RAK	SAMPLE DATE :	08/06/92
SAMPLE SOURCE :	TP-10	SUBMITTAL DATE:	08/06/92
ANALYST :	NKT	ANALYSIS DATE :	08/06/92

Organic Monitoring-Drinking Water Volatiles
Full Suite

Sample Analysis

Parameter	Result	Unit	Detection Level
Benzene	1.928	mg/L	0.005
Bromobenzene	N/A	mg/L	0.005
Bromochloromethane	N/A	mg/L	0.005
Bromodichloromethane	N/A	mg/L	0.005
Bromoform	N/A	mg/L	0.005
Bromomethane	N/A	mg/L	0.005
n-Butylbenzene	N/A	mg/L	0.005
sec-Butylbenzene	N/A	mg/L	0.005
tert-Butylbenzene	N/A	mg/L	0.005
Carbon tetrachloride	N/A	mg/L	0.005
Chlorobenzene	N/A	mg/L	0.005
Chloroethane	N/A	mg/L	0.005
Chloroform	N/A	mg/L	0.005
Chloromethane	N/A	mg/L	0.005
2-Chlorotoluene (ortho)	N/A	mg/L	0.005
4-Chlorotoluene (para)	N/A	mg/L	0.005
1,2-Dibromoethane (EDB)	N/A	mg/L	0.005
1,2-Dibromo-3-chloropropane	N/A	mg/L	0.005
Dibromochloromethane	N/A	mg/L	0.005
Dibromomethane	N/A	mg/L	0.005
1,2-Dichlorobenzene (ortho)	N/A	mg/L	0.005
1,3-Dichlorobenzene (meta)	N/A	mg/L	0.005
1,4-Dichlorobenzene (para)	N/A	mg/L	0.005
Dichlorodifluoromethane	N/A	mg/L	0.005
1,1-Dichloroethane	N/A	mg/L	0.005
1,2-Dichloroethane	N/A	mg/L	0.005

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT: James M. Montgomery
4525 S. Wasatch Blvd.
SLC, Utah 84124

SAMPLE SOURCE: TP-10

PROJECT NO. : 92-1016
SAMPLE NO. : 38
REPORT DATE : 10/09/92
REVIEWED BY : RAK

Sample Analysis			
Parameter	Result	Unit	Detection Level
cis 1,2-Dichloroethene	N/A	mg/L	0.005
trans 1,2-Dichloroethene ..	N/A	mg/L	0.005
1,2-Dichloropropane	N/A	mg/L	0.005
1,3-Dichloropropane	N/A	mg/L	0.005
2,2-Dichloropropane	N/A	mg/L	0.005
1,1-Dichloropropene	N/A	mg/L	0.005
1,1-Dichloroethene	N/A	mg/L	0.005
cis 1,3-Dichloropropene ...	N/A	mg/L	0.005
trans 1,3-Dichloropropene .	N/A	mg/L	0.005
Ethylbenzene	< 0.005	mg/L	0.005
Hexachlorobutadiene	N/A	mg/L	0.005
Isoproylbenzene	N/A	mg/L	0.005
4-Isopropyltoluene	N/A	mg/L	0.005
Dichloromethane	N/A	mg/L	0.005
Napthalene	N/A	mg/L	0.005
Propylbenzene	N/A	mg/L	0.005
Styrene	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethane .	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethene (Tetrachloroethylene)	3.618	mg/L	0.005
1,1,1,2-Tetrachloroethane .	N/A	mg/L	0.005
Toluene	3.214	mg/L	0.005
1,2,3-Trichlorobenzene	N/A	mg/L	0.005
1,2,4-Trichlorobenzene	N/A	mg/L	0.005
1,1,1-Trichloroethane	N/A	mg/L	0.005
1,1,2-Trichloroethane	N/A	mg/L	0.005
Trichloroethene (TCE)	N/A	mg/L	0.005
Fluorotrichloromethane	N/A	mg/L	0.005
1,2,3-Trichloropropane	N/A	mg/L	0.005
1,2,4-Trimethylbenzene	N/A	mg/L	0.005
1,3,5-Trimethylbenzene	N/A	mg/L	0.005
Vinyl chloride	N/A	mg/L	0.005
p-m-Xylene	1.854	mg/L	0.005
o-Xylene	1.976	mg/L	0.005

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT:	James M. Montgomery 4525 S. Wasatch Blvd. SLC, Utah 84124 Attn: David A. Fulton	PROJECT NO. : SAMPLE NO. : REPORT DATE : REVIEWED BY : PAGE :	92-1016 55 10/09/92 RAK 1 OF 2

CLIENT ID NO.	: None	AUTHORIZED BY	: DAF
SAMPLE MATRIX	: Ground Water	CLIENT P.O.	: None
SAMPLED BY	: NKT/RAK	SAMPLE DATE	: 08/07/92
SAMPLE SOURCE	: TP-12	SUBMITTAL DATE:	08/07/92
ANALYST	: NKT	ANALYSIS DATE	: 08/07/92

Organic Monitoring-Drinking Water Volatiles
Full Suite

Sample Analysis

Parameter	Result	Unit	Detection Level
Benzene	1.163	mg/L	0.005
Bromobenzene	N/A	mg/L	0.005
Bromochloromethane	N/A	mg/L	0.005
Bromodichloromethane	N/A	mg/L	0.005
Bromoform	N/A	mg/L	0.005
Bromomethane	N/A	mg/L	0.005
n-Butylbenzene	N/A	mg/L	0.005
sec-Butylbenzene	N/A	mg/L	0.005
tert-Butylbenzene	N/A	mg/L	0.005
Carbon tetrachloride	N/A	mg/L	0.005
Chlorobenzene	N/A	mg/L	0.005
Chloroethane	N/A	mg/L	0.005
Chloroform	N/A	mg/L	0.005
Chloromethane	N/A	mg/L	0.005
2-Chlorotoluene (ortho) ...	N/A	mg/L	0.005
4-Chlorotoluene (para)	N/A	mg/L	0.005
1,2-Dibromoethane (EDB) ...	N/A	mg/L	0.005
1,2-Dibromo-3-chloropropane	N/A	mg/L	0.005
Dibromochloromethane	N/A	mg/L	0.005
Dibromomethane	N/A	mg/L	0.005
1,2-Dichlorobenzene (ortho)	N/A	mg/L	0.005
1,3-Dichlorobenzene (meta)	N/A	mg/L	0.005
1,4-Dichlorobenzene (para)	N/A	mg/L	0.005
Dichlorodifluoromethane ...	N/A	mg/L	0.005
1,1-Dichloroethane	N/A	mg/L	0.005
1,2-Dichloroethane	N/A	mg/L	0.005

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT: James M. Montgomery
4525 S. Wasatch Blvd.
SLC, Utah 84124

SAMPLE SOURCE: TP-12

PROJECT NO. : 92-1016
SAMPLE NO. : 55
REPORT DATE : 10/09/92
REVIEWED BY : RAK

Sample Analysis

Parameter	Result	Unit	Detection Level
cis 1,2-Dichloroethene	N/A	mg/L	0.005
trans 1,2-Dichloroethene ..	N/A	mg/L	0.005
1,2-Dichloropropane	N/A	mg/L	0.005
1,3-Dichloropropane	N/A	mg/L	0.005
2,2-Dichloropropane	N/A	mg/L	0.005
1,1-Dichloropropene	N/A	mg/L	0.005
1,1-Dichloroethene	N/A	mg/L	0.005
cis 1,3-Dichloropropene ...	N/A	mg/L	0.005
trans 1,3-Dichloropropene .	N/A	mg/L	0.005
Ethylbenzene	0.062	mg/L	0.005
Hexachlorobutadiene	N/A	mg/L	0.005
Isoproylbenzene	N/A	mg/L	0.005
4-Isopropyltoluene	N/A	mg/L	0.005
Dichloromethane	N/A	mg/L	0.005
Napthalene	N/A	mg/L	0.005
Propylbenzene	N/A	mg/L	0.005
Styrene	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethane .	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethene (Tetrachloroethylene)	0.636	mg/L	0.005
1,1,1,2-Tetrachloroethane .	N/A	mg/L	0.005
Toluene	0.565	mg/L	0.005
1,2,3-Trichlorobenzene	N/A	mg/L	0.005
1,2,4-Trichlorobenzene	N/A	mg/L	0.005
1,1,1-Trichloroethane	N/A	mg/L	0.005
1,1,2-Trichloroethane	N/A	mg/L	0.005
Trichloroethene (TCE)	N/A	mg/L	0.005
Fluorotrichloromethane	N/A	mg/L	0.005
1,2,3-Trichloropropane	N/A	mg/L	0.005
1,2,4-Trimethylbenzene	N/A	mg/L	0.005
1,3,5-Trimethylbenzene	N/A	mg/L	0.005
Vinyl chloride	N/A	mg/L	0.005
p-m-Xylene	0.215	mg/L	0.005
o-Xylene	0.050	mg/L	0.005

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT: James M. Montgomery
4525 S. Wasatch Blvd.
SLC, Utah 84124

Attn: David A. Fulton

PROJECT NO. : 92-1016
SAMPLE NO. : 58
REPORT DATE : 10/09/92
REVIEWED BY : RAK
PAGE : 1 OF 2

CLIENT ID NO. : None
SAMPLE MATRIX : Ground Water
SAMPLED BY : NKT/RAK
SAMPLE SOURCE : TP-13
ANALYST : NKT

AUTHORIZED BY : DAF
CLIENT P.O. : None
SAMPLE DATE : 08/07/92
SUBMITTAL DATE: 08/07/92
ANALYSIS DATE : 08/07/92

Organic Monitoring-Drinking Water Volatiles
Full Suite

Sample Analysis

Parameter	Result	Unit	Detection Level
Benzene	< 0.005	mg/L	0.005
Bromobenzene	N/A	mg/L	0.005
Bromochloromethane	N/A	mg/L	0.005
Bromodichloromethane	N/A	mg/L	0.005
Bromoform	N/A	mg/L	0.005
Bromomethane	N/A	mg/L	0.005
n-Butylbenzene	N/A	mg/L	0.005
sec-Butylbenzene	N/A	mg/L	0.005
tert-Butylbenzene	N/A	mg/L	0.005
Carbon tetrachloride	N/A	mg/L	0.005
Chlorobenzene	N/A	mg/L	0.005
Chloroethane	N/A	mg/L	0.005
Chloroform	N/A	mg/L	0.005
Chloromethane	N/A	mg/L	0.005
2-Chlorotoluene (ortho) ...	N/A	mg/L	0.005
4-Chlorotoluene (para)	N/A	mg/L	0.005
1,2-Dibromoethane (EDB) ...	N/A	mg/L	0.005
1,2-Dibromo-3-chloropropane	N/A	mg/L	0.005
Dibromochloromethane	N/A	mg/L	0.005
Dibromomethane	N/A	mg/L	0.005
1,2-Dichlorobenzene (ortho)	N/A	mg/L	0.005
1,3-Dichlorobenzene (meta)	N/A	mg/L	0.005
1,4-Dichlorobenzene (para)	N/A	mg/L	0.005
Dichlorodifluoromethane ...	N/A	mg/L	0.005
1,1-Dichloroethane	N/A	mg/L	0.005
1,2-Dichloroethane	N/A	mg/L	0.005

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT:	James M. Montgomery 4525 S. Wasatch Blvd. SLC, Utah 84124	PROJECT NO. : SAMPLE NO. : REPORT DATE : REVIEWED BY :	92-1016 58 10/09/92 RAK
	SAMPLE SOURCE: TP-13	PAGE :	2 OF 2

Sample Analysis

Parameter	Result	Unit	Detection Level
cis 1,2-Dichloroethene	N/A	mg/L	0.005
trans 1,2-Dichloroethene ..	N/A	mg/L	0.005
1,2-Dichloropropane	N/A	mg/L	0.005
1,3-Dichloropropane	N/A	mg/L	0.005
2,2-Dichloropropane	N/A	mg/L	0.005
1,1-Dichloropropene	N/A	mg/L	0.005
1,1-Dichloroethene	N/A	mg/L	0.005
cis 1,3-Dichloropropene ...	N/A	mg/L	0.005
trans 1,3-Dichloropropene .	N/A	mg/L	0.005
Ethylbenzene	< 0.005	mg/L	0.005
Hexachlorobutadiene	N/A	mg/L	0.005
Isoproylbenzene	N/A	mg/L	0.005
4-Isopropyltoluene	N/A	mg/L	0.005
Dichloromethane	N/A	mg/L	0.005
Napthalene	N/A	mg/L	0.005
Propylbenzene	N/A	mg/L	0.005
Styrene	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethane .	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethene (Tetrachloroethylene)	< 0.005	mg/L	0.005
1,1,1,2-Tetrachloroethane .	N/A	mg/L	0.005
Toluene	0.069	mg/L	0.005
1,2,3-Trichlorobenzene	N/A	mg/L	0.005
1,2,4-Trichlorobenzene	N/A	mg/L	0.005
1,1,1-Trichloroethane	N/A	mg/L	0.005
1,1,2-Trichloroethane	N/A	mg/L	0.005
Trichloroethene (TCE)	N/A	mg/L	0.005
Fluorotrichloromethane	N/A	mg/L	0.005
1,2,3-Trichloropropane	N/A	mg/L	0.005
1,2,4-Trimethylbenzene	N/A	mg/L	0.005
1,3,5-Trimethylbenzene	N/A	mg/L	0.005
Vinyl chloride	N/A	mg/L	0.005
p-m-Xylene	0.062	mg/L	0.005
o-Xylene	< 0.005	mg/L	0.005

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT: James M. Montgomery
4525 S. Wasatch Blvd.
SLC, Utah 84124

Attn: David A. Fulton

PROJECT NO. : 92-1016
SAMPLE NO. : 59
REPORT DATE : 10/09/92
REVIEWED BY : RAK
PAGE : 1 OF 2

CLIENT ID NO. : None
SAMPLE MATRIX : Ground Water
SAMPLED BY : NKT/RAK
SAMPLE SOURCE : TP-14
ANALYST : NKT

AUTHORIZED BY : DAF
CLIENT P.O. : None
SAMPLE DATE : 08/07/92
SUBMITTAL DATE: 08/07/92
ANALYSIS DATE : 08/07/92

Organic Monitoring-Drinking Water Volatiles
Full Suite

Sample Analysis			
Parameter	Result	Unit	Detection Level
Benzene	1.440	mg/L	0.005
Bromobenzene	N/A	mg/L	0.005
Bromochloromethane	N/A	mg/L	0.005
Bromodichloromethane	N/A	mg/L	0.005
Bromoform	N/A	mg/L	0.005
Bromomethane	N/A	mg/L	0.005
n-Butylbenzene	N/A	mg/L	0.005
sec-Butylbenzene	N/A	mg/L	0.005
tert-Butylbenzene	N/A	mg/L	0.005
Carbon tetrachloride	N/A	mg/L	0.005
Chlorobenzene	N/A	mg/L	0.005
Chloroethane	N/A	mg/L	0.005
Chloroform	N/A	mg/L	0.005
Chloromethane	N/A	mg/L	0.005
2-Chlorotoluene (ortho) ...	N/A	mg/L	0.005
4-Chlorotoluene (para)	N/A	mg/L	0.005
1,2-Dibromoethane (EDB) ...	N/A	mg/L	0.005
1,2-Dibromo-3-chloropropane	N/A	mg/L	0.005
Dibromochloromethane	N/A	mg/L	0.005
Dibromomethane	N/A	mg/L	0.005
1,2-Dichlorobenzene (ortho)	N/A	mg/L	0.005
1,3-Dichlorobenzene (meta)	N/A	mg/L	0.005
1,4-Dichlorobenzene (para)	N/A	mg/L	0.005
Dichlorodifluoromethane ...	N/A	mg/L	0.005
1,1-Dichloroethane	N/A	mg/L	0.005
1,2-Dichloroethane	N/A	mg/L	0.005

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT: James M. Montgomery
4525 S. Wasatch Blvd.
SLC, Utah 84124

SAMPLE SOURCE: TP-14

PROJECT NO. : 92-1016
SAMPLE NO. : 59
REPORT DATE : 10/09/92
REVIEWED BY : RAK

Sample Analysis

Parameter	Result	Unit	Detection Level
cis 1,2-Dichloroethene	N/A	mg/L	0.005
trans 1,2-Dichloroethene ..	N/A	mg/L	0.005
1,2-Dichloropropane	N/A	mg/L	0.005
1,3-Dichloropropane	N/A	mg/L	0.005
2,2-Dichloropropane	N/A	mg/L	0.005
1,1-Dichloropropene	N/A	mg/L	0.005
1,1-Dichloroethene	N/A	mg/L	0.005
cis 1,3-Dichloropropene ...	N/A	mg/L	0.005
trans 1,3-Dichloropropene .	N/A	mg/L	0.005
Ethylbenzene	0.338	mg/L	0.005
Hexachlorobutadiene	N/A	mg/L	0.005
Isoproylbenzene	N/A	mg/L	0.005
4-Isopropyltoluene	N/A	mg/L	0.005
Dichloromethane	N/A	mg/L	0.005
Napthalene	N/A	mg/L	0.005
Propylbenzene	N/A	mg/L	0.005
Styrene	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethane .	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethene (Tetrachloroethylene)	< 0.005	mg/L	0.005
1,1,1,2-Tetrachloroethane .	N/A	mg/L	0.005
Toluene	0.392	mg/L	0.005
1,2,3-Trichlorobenzene	N/A	mg/L	0.005
1,2,4-Trichlorobenzene	N/A	mg/L	0.005
1,1,1-Trichloroethane	N/A	mg/L	0.005
1,1,2-Trichloroethane	N/A	mg/L	0.005
Trichloroethene (TCE)	N/A	mg/L	0.005
Fluorotrichloromethane	N/A	mg/L	0.005
1,2,3-Trichloropropane	N/A	mg/L	0.005
1,2,4-Trimethylbenzene	N/A	mg/L	0.005
1,3,5-Trimethylbenzene	N/A	mg/L	0.005
Vinyl chloride	N/A	mg/L	0.005
p-m-Xylene	0.930	mg/L	0.005
o-Xylene	0.448	mg/L	0.005

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT: James M. Montgomery
4525 S. Wasatch Blvd.
SLC, Utah 84124

Attn: David A. Fulton

PROJECT NO. : 92-1016
SAMPLE NO. : 68
REPORT DATE : 10/09/92
REVIEWED BY : RAK
PAGE : 1 OF 2

CLIENT ID NO. : None
SAMPLE MATRIX : Ground Water
SAMPLED BY : NKT/RAK
SAMPLE SOURCE : TP-17
ANALYST : NKT

AUTHORIZED BY : DAF
CLIENT P.O. : None
SAMPLE DATE : 08/08/92
SUBMITTAL DATE: 08/08/92
ANALYSIS DATE : 08/08/92

Organic Monitoring-Drinking Water Volatiles
Full Suite

Sample Analysis

Parameter	Result	Unit	Detection Level
Benzene	< 0.005	mg/L	0.005
Bromobenzene	N/A	mg/L	0.005
Bromochloromethane	N/A	mg/L	0.005
Bromodichloromethane	N/A	mg/L	0.005
Bromoform	N/A	mg/L	0.005
Bromomethane	N/A	mg/L	0.005
n-Butylbenzene	N/A	mg/L	0.005
sec-Butylbenzene	N/A	mg/L	0.005
tert-Butylbenzene	N/A	mg/L	0.005
Carbon tetrachloride	N/A	mg/L	0.005
Chlorobenzene	N/A	mg/L	0.005
Chloroethane	N/A	mg/L	0.005
Chloroform	N/A	mg/L	0.005
Chloromethane	N/A	mg/L	0.005
2-Chlorotoluene (ortho) ...	N/A	mg/L	0.005
4-Chlorotoluene (para)	N/A	mg/L	0.005
1,2-Dibromoethane (EDB) ...	N/A	mg/L	0.005
1,2-Dibromo-3-chloropropane	N/A	mg/L	0.005
Dibromochloromethane	N/A	mg/L	0.005
Dibromomethane	N/A	mg/L	0.005
1,2-Dichlorobenzene (ortho)	N/A	mg/L	0.005
1,3-Dichlorobenzene (meta)	N/A	mg/L	0.005
1,4-Dichlorobenzene (para)	N/A	mg/L	0.005
Dichlorodifluoromethane ...	N/A	mg/L	0.005
1,1-Dichloroethane	N/A	mg/L	0.005
1,2-Dichloroethane	N/A	mg/L	0.005

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT: James M. Montgomery
4525 S. Wasatch Blvd.
SLC, Utah 84124

SAMPLE SOURCE: TP-17

PROJECT NO. : 92-1016
SAMPLE NO. : 68
REPORT DATE : 10/09/92
REVIEWED BY : RAK

Sample Analysis

Parameter	Result	Unit	Detection Level
cis 1,2-Dichloroethene	N/A	mg/L	0.005
trans 1,2-Dichloroethene ..	N/A	mg/L	0.005
1,2-Dichloropropane	N/A	mg/L	0.005
1,3-Dichloropropane	N/A	mg/L	0.005
2,2-Dichloropropane	N/A	mg/L	0.005
1,1-Dichloropropene	N/A	mg/L	0.005
1,1-Dichloroethene	N/A	mg/L	0.005
cis 1,3-Dichloropropene ...	N/A	mg/L	0.005
trans 1,3-Dichloropropene .	N/A	mg/L	0.005
Ethylbenzene	0.014	mg/L	0.005
Hexachlorobutadiene	N/A	mg/L	0.005
Isoproylbenzene	N/A	mg/L	0.005
4-Isopropyltoluene	N/A	mg/L	0.005
Dichloromethane	N/A	mg/L	0.005
Napthalene	N/A	mg/L	0.005
Propylbenzene	N/A	mg/L	0.005
Styrene	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethane .	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethene (Tetrachloroethylene)	< 0.005	mg/L	0.005
1,1,1,2-Tetrachloroethane .	N/A	mg/L	0.005
Toluene	< 0.005	mg/L	0.005
1,2,3-Trichlorobenzene	N/A	mg/L	0.005
1,2,4-Trichlorobenzene	N/A	mg/L	0.005
1,1,1-Trichloroethane	N/A	mg/L	0.005
1,1,2-Trichloroethane	N/A	mg/L	0.005
Trichloroethene (TCE)	N/A	mg/L	0.005
Fluorotrichloromethane	N/A	mg/L	0.005
1,2,3-Trichloropropane	N/A	mg/L	0.005
1,2,4-Trimethylbenzene	N/A	mg/L	0.005
1,3,5-Trimethylbenzene	N/A	mg/L	0.005
Vinyl chloride	N/A	mg/L	0.005
p-m-Xylene	0.057	mg/L	0.005
o-Xylene	< 0.005	mg/L	0.005

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT: James M. Montgomery
4525 S. Wasatch Blvd.
SLC, Utah 84124

Attn: David A. Fulton

PROJECT NO. : 92-1016
SAMPLE NO. : 72
REPORT DATE : 10/09/92
REVIEWED BY : RAK
PAGE : 1 OF 2

CLIENT ID NO. : None
SAMPLE MATRIX : Ground Water
SAMPLED BY : NKT/RAK
SAMPLE SOURCE : TP-19
ANALYST : NKT

AUTHORIZED BY : DAF
CLIENT P.O. : None
SAMPLE DATE : 08/08/92
SUBMITTAL DATE: 08/08/92
ANALYSIS DATE : 08/08/92

Organic Monitoring-Drinking Water Volatiles
Full Suite

Sample Analysis			
Parameter	Result	Unit	Detection Level
Benzene	0.646	mg/L	0.005
Bromobenzene	N/A	mg/L	0.005
Bromochloromethane	N/A	mg/L	0.005
Bromodichloromethane	N/A	mg/L	0.005
Bromoform	N/A	mg/L	0.005
Bromomethane	N/A	mg/L	0.005
n-Butylbenzene	N/A	mg/L	0.005
sec-Butylbenzene	N/A	mg/L	0.005
tert-Butylbenzene	N/A	mg/L	0.005
Carbon tetrachloride	N/A	mg/L	0.005
Chlorobenzene	N/A	mg/L	0.005
Chloroethane	N/A	mg/L	0.005
Chloroform	N/A	mg/L	0.005
Chloromethane	N/A	mg/L	0.005
2-Chlorotoluene (ortho) ...	N/A	mg/L	0.005
4-Chlorotoluene (para)	N/A	mg/L	0.005
1,2-Dibromoethane (EDB) ...	N/A	mg/L	0.005
1,2-Dibromo-3-chloropropane	N/A	mg/L	0.005
Dibromochloromethane	N/A	mg/L	0.005
Dibromomethane	N/A	mg/L	0.005
1,2-Dichlorobenzene (ortho)	N/A	mg/L	0.005
1,3-Dichlorobenzene (meta)	N/A	mg/L	0.005
1,4-Dichlorobenzene (para)	N/A	mg/L	0.005
Dichlorodifluoromethane ...	N/A	mg/L	0.005
1,1-Dichloroethane	N/A	mg/L	0.005
1,2-Dichloroethane	N/A	mg/L	0.005

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT: James M. Montgomery
4525 S. Wasatch Blvd.
SLC, Utah 84124

SAMPLE SOURCE: TP-19

PROJECT NO. : 92-1016
SAMPLE NO. : 72
REPORT DATE : 10/09/92
REVIEWED BY : RAK

Sample Analysis

Parameter	Result	Unit	Detection Level
cis 1,2-Dichloroethene	N/A	mg/L	0.005
trans 1,2-Dichloroethene ..	N/A	mg/L	0.005
1,2-Dichloropropane	N/A	mg/L	0.005
1,3-Dichloropropane	N/A	mg/L	0.005
2,2-Dichloropropane	N/A	mg/L	0.005
1,1-Dichloropropene	N/A	mg/L	0.005
1,1-Dichloroethene	N/A	mg/L	0.005
cis 1,3-Dichloropropene ...	N/A	mg/L	0.005
trans 1,3-Dichloropropene .	N/A	mg/L	0.005
Ethylbenzene	0.036	mg/L	0.005
Hexachlorobutadiene	N/A	mg/L	0.005
Isoproylbenzene	N/A	mg/L	0.005
4-Isopropyltoluene	N/A	mg/L	0.005
Dichloromethane	N/A	mg/L	0.005
Napthalene	N/A	mg/L	0.005
Propylbenzene	N/A	mg/L	0.005
Styrene	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethane .	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethene (Tetrachloroethylene)	0.125	mg/L	0.005
1,1,1,2-Tetrachloroethane .	N/A	mg/L	0.005
Toluene	< 0.005	mg/L	0.005
1,2,3-Trichlorobenzene	N/A	mg/L	0.005
1,2,4-Trichlorobenzene	N/A	mg/L	0.005
1,1,1-Trichloroethane	N/A	mg/L	0.005
1,1,2-Trichloroethane	N/A	mg/L	0.005
Trichloroethene (TCE)	N/A	mg/L	0.005
Fluorotrichloromethane	N/A	mg/L	0.005
1,2,3-Trichloropropane	N/A	mg/L	0.005
1,2,4-Trimethylbenzene	N/A	mg/L	0.005
1,3,5-Trimethylbenzene	N/A	mg/L	0.005
Vinyl chloride	N/A	mg/L	0.005
p-m-Xylene	0.149	mg/L	0.005
o-Xylene	< 0.005	mg/L	0.005

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT:	James M. Montgomery 4525 S. Wasatch Blvd. SLC, Utah 84124	PROJECT NO. :	92-1016
		SAMPLE NO. :	73
		REPORT DATE :	10/09/92
		REVIEWED BY :	RAK
	Attn: David A. Fulton	PAGE :	1 OF 2

CLIENT ID NO. :	None	AUTHORIZED BY :	DAF
SAMPLE MATRIX :	Ground Water	CLIENT P.O. :	None
SAMPLED BY :	NKT/RAK	SAMPLE DATE :	08/08/92
SAMPLE SOURCE :	TP-20	SUBMITTAL DATE:	08/08/92
ANALYST :	NKT	ANALYSIS DATE :	08/08/92

Organic Monitoring ...ng Water Volatiles
Full Suite

Sample Analysis

Parameter	Result	Unit	Detection Level
Benzene	0.124	mg/L	0.005
Bromobenzene	N/A	mg/L	0.005
Bromochloromethane	N/A	mg/L	0.005
Bromodichloromethane	N/A	mg/L	0.005
Bromoform	N/A	mg/L	0.005
Bromomethane	N/A	mg/L	0.005
n-Butylbenzene	N/A	mg/L	0.005
sec-Butylbenzene	N/A	mg/L	0.005
tert-Butylbenzene	N/A	mg/L	0.005
Carbon tetrachloride	N/A	mg/L	0.005
Chlorobenzene	N/A	mg/L	0.005
Chloroethane	N/A	mg/L	0.005
Chloroform	N/A	mg/L	0.005
Chloromethane	N/A	mg/L	0.005
2-Chlorotoluene (ortho) ...	N/A	mg/L	0.005
4-Chlorotoluene (para)	N/A	mg/L	0.005
1,2-Dibromoethane (EDB) ...	N/A	mg/L	0.005
1,2-Dibromo-3-chloropropane	N/A	mg/L	0.005
Dibromochloromethane	N/A	mg/L	0.005
Dibromomethane	N/A	mg/L	0.005
1,2-Dichlorobenzene (ortho)	N/A	mg/L	0.005
1,3-Dichlorobenzene (meta)	N/A	mg/L	0.005
1,4-Dichlorobenzene (para)	N/A	mg/L	0.005
Dichlorodifluoromethane ...	N/A	mg/L	0.005
1,1-Dichloroethane	N/A	mg/L	0.005
1,2-Dichloroethane	N/A	mg/L	0.005

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT: James M. Montgomery
4525 S. Wasatch Blvd.
SLC, Utah 84124

SAMPLE SOURCE: TP-20

PROJECT NO. : 92-1016
SAMPLE NO. : 73
REPORT DATE : 10/09/92
REVIEWED BY : RAK

Sample Analysis

Parameter	Result	Unit	Detection Level
cis 1,2-Dichloroethene	N/A	mg/L	0.005
trans 1,2-Dichloroethene ..	N/A	mg/L	0.005
1,2-Dichloropropane	N/A	mg/L	0.005
1,3-Dichloropropane	N/A	mg/L	0.005
2,2-Dichloropropane	N/A	mg/L	0.005
1,1-Dichloropropene	N/A	mg/L	0.005
1,1-Dichloroethene	N/A	mg/L	0.005
cis 1,3-Dichloropropene ...	N/A	mg/L	0.005
trans 1,3-Dichloropropene .	N/A	mg/L	0.005
Ethylbenzene	< 0.005	mg/L	0.005
Hexachlorobutadiene	N/A	mg/L	0.005
Isoproylbenzene	N/A	mg/L	0.005
4-Isopropyltoluene	N/A	mg/L	0.005
Dichloromethane	N/A	mg/L	0.005
Napthalene	N/A	mg/L	0.005
Propylbenzene	N/A	mg/L	0.005
Styrene	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethane .	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethene (Tetrachloroethylene)	0.303	mg/L	0.005
1,1,1,2-Tetrachloroethane .	N/A	mg/L	0.005
Toluene	2.699	mg/L	0.005
1,2,3-Trichlorobenzene	N/A	mg/L	0.005
1,2,4-Trichlorobenzene	N/A	mg/L	0.005
1,1,1-Trichloroethane	N/A	mg/L	0.005
1,1,2-Trichloroethane	N/A	mg/L	0.005
Trichloroethene (TCE)	N/A	mg/L	0.005
Fluorotrichloromethane	N/A	mg/L	0.005
1,2,3-Trichloropropane	N/A	mg/L	0.005
1,2,4-Trimethylbenzene	N/A	mg/L	0.005
1,3,5-Trimethylbenzene	N/A	mg/L	0.005
Vinyl chloride	N/A	mg/L	0.005
p-m-Xylene	< 0.005	mg/L	0.005
o-Xylene	0.504	mg/L	0.005

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT:	James M. Montgomery 4525 S. Wasatch Blvd. SLC, Utah 84124	PROJECT NO. :	92-1016
		SAMPLE NO. :	74
		REPORT DATE :	10/09/92
		REVIEWED BY :	RAK
	Attn: David A. Fulton	PAGE :	1 OF 2

CLIENT ID NO. :	None	AUTHORIZED BY :	DAF
SAMPLE MATRIX :	Ground Water	CLIENT P.O. :	None
SAMPLED BY :	NKT/RAK	SAMPLE DATE :	08/08/92
SAMPLE SOURCE :	TP-21	SUBMITTAL DATE:	08/08/92
ANALYST :	NKT	ANALYSIS DATE :	08/08/92

Organic Monitoring-Drinking Water Volatiles
Full Suite

Sample Analysis

Parameter	Result	Unit	Detection Level
Benzene	< 0.005	mg/L	0.005
Bromobenzene	N/A	mg/L	0.005
Bromochloromethane	N/A	mg/L	0.005
Bromodichloromethane	N/A	mg/L	0.005
Bromoform	N/A	mg/L	0.005
Bromomethane	N/A	mg/L	0.005
n-Butylbenzene	N/A	mg/L	0.005
sec-Butylbenzene	N/A	mg/L	0.005
tert-Butylbenzene	N/A	mg/L	0.005
Carbon tetrachloride	N/A	mg/L	0.005
Chlorobenzene	N/A	mg/L	0.005
Chloroethane	N/A	mg/L	0.005
Chloroform	N/A	mg/L	0.005
Chloromethane	N/A	mg/L	0.005
2-Chlorotoluene (ortho) ...	N/A	mg/L	0.005
4-Chlorotoluene (para)	N/A	mg/L	0.005
1,2-Dibromoethane (EDB) ...	N/A	mg/L	0.005
1,2-Dibromo-3-chloropropane	N/A	mg/L	0.005
Dibromochloromethane	N/A	mg/L	0.005
Dibromomethane	N/A	mg/L	0.005
1,2-Dichlorobenzene (ortho)	N/A	mg/L	0.005
1,3-Dichlorobenzene (meta)	N/A	mg/L	0.005
1,4-Dichlorobenzene (para)	N/A	mg/L	0.005
Dichlorodifluoromethane ...	N/A	mg/L	0.005
1,1-Dichloroethane	N/A	mg/L	0.005
1,2-Dichloroethane	N/A	mg/L	0.005

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT: James M. Montgomery
4525 S. Wasatch Blvd.
SLC, Utah 84124

SAMPLE SOURCE: TP-21

PROJECT NO. : 92-1016
SAMPLE NO. : 74
REPORT DATE : 10/09/92
REVIEWED BY : RAK

Sample Analysis			
Parameter	Result	Unit	Detection Level
cis 1,2-Dichloroethene	N/A	mg/L	0.005
trans 1,2-Dichloroethene ..	N/A	mg/L	0.005
1,2-Dichloropropane	N/A	mg/L	0.005
1,3-Dichloropropane	N/A	mg/L	0.005
2,2-Dichloropropane	N/A	mg/L	0.005
1,1-Dichloropropene	N/A	mg/L	0.005
1,1-Dichloroethene	N/A	mg/L	0.005
cis 1,3-Dichloropropene ...	N/A	mg/L	0.005
trans 1,3-Dichloropropene .	N/A	mg/L	0.005
Ethylbenzene	< 0.005	mg/L	0.005
Hexachlorobutadiene	N/A	mg/L	0.005
Isoproylbenzene	N/A	mg/L	0.005
4-Isopropyltoluene	N/A	mg/L	0.005
Dichloromethane	N/A	mg/L	0.005
Napthalene	N/A	mg/L	0.005
Propylbenzene	N/A	mg/L	0.005
Styrene	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethane .	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethene (Tetrachloroethylene)	< 0.005	mg/L	0.005
1,1,1,2-Tetrachloroethane .	N/A	mg/L	0.005
Toluene	< 0.005	mg/L	0.005
1,2,3-Trichlorobenzene	N/A	mg/L	0.005
1,2,4-Trichlorobenzene	N/A	mg/L	0.005
1,1,1-Trichloroethane	N/A	mg/L	0.005
1,1,2-Trichloroethane	N/A	mg/L	0.005
Trichloroethene (TCE)	N/A	mg/L	0.005
Fluorotrichloromethane	N/A	mg/L	0.005
1,2,3-Trichloropropane	N/A	mg/L	0.005
1,2,4-Trimethylbenzene	N/A	mg/L	0.005
1,3,5-Trimethylbenzene	N/A	mg/L	0.005
Vinyl chloride	N/A	mg/L	0.005
p-m-Xylene	0.057	mg/L	0.005
o-Xylene	< 0.005	mg/L	0.005

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT: James M. Montgomery
4525 S. Wasatch Blvd.
SLC, Utah 84124

Attn: David A. Fulton

PROJECT NO. : 92-1016
SAMPLE NO. : 83
REPORT DATE : 10/09/92
REVIEWED BY : RAK
PAGE : 1 OF 2

CLIENT ID NO. : None
SAMPLE MATRIX : Ground Water
SAMPLED BY : NKT/RAK
SAMPLE SOURCE : TP-22
ANALYST : NKT

AUTHORIZED BY : DAF
CLIENT P.O. : None
SAMPLE DATE : 08/09/92
SUBMITTAL DATE: 08/10/92
ANALYSIS DATE : 08/10/92

Organic Monitoring-Drinking Water Volatiles
Full Suite

Sample Analysis			
Parameter	Result	Unit	Detection Level
Benzene	0.056	mg/L	0.005
Bromobenzene	N/A	mg/L	0.005
Bromochloromethane	N/A	mg/L	0.005
Bromodichloromethane	N/A	mg/L	0.005
Bromoform	N/A	mg/L	0.005
Bromomethane	N/A	mg/L	0.005
n-Butylbenzene	N/A	mg/L	0.005
sec-Butylbenzene	N/A	mg/L	0.005
tert-Butylbenzene	N/A	mg/L	0.005
Carbon tetrachloride	N/A	mg/L	0.005
Chlorobenzene	N/A	mg/L	0.005
Chloroethane	N/A	mg/L	0.005
Chloroform	N/A	mg/L	0.005
Chloromethane	N/A	mg/L	0.005
2-Chlorotoluene (ortho) ...	N/A	mg/L	0.005
4-Chlorotoluene (para)	N/A	mg/L	0.005
1,2-Dibromoethane (EDB) ...	N/A	mg/L	0.005
1,2-Dibromo-3-chloropropane	N/A	mg/L	0.005
Dibromochloromethane	N/A	mg/L	0.005
Dibromomethane	N/A	mg/L	0.005
1,2-Dichlorobenzene (ortho)	N/A	mg/L	0.005
1,3-Dichlorobenzene (meta)	N/A	mg/L	0.005
1,4-Dichlorobenzene (para)	N/A	mg/L	0.005
Dichlorodifluoromethane ...	N/A	mg/L	0.005
1,1-Dichloroethane	N/A	mg/L	0.005
1,2-Dichloroethane	N/A	mg/L	0.005

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT: James M. Montgomery
4525 S. Wasatch Blvd.
SLC, Utah 84124

SAMPLE SOURCE: TP-22

PROJECT NO. : 92-1016
SAMPLE NO. : 83
REPORT DATE : 10/09/92
REVIEWED BY : RAK
PAGE : 2 OF 2

Sample Analysis			
Parameter	Result	Unit	Detection Level
cis 1,2-Dichloroethene ...	N/A	mg/L	0.005
trans 1,2-Dichloroethene ..	N/A	mg/L	0.005
1,2-Dichloropropane	N/A	mg/L	0.005
1,3-Dichloropropane	N/A	mg/L	0.005
2,2-Dichloropropane	N/A	mg/L	0.005
1,1-Dichloropropene	N/A	mg/L	0.005
1,1-Dichloroethene	N/A	mg/L	0.005
cis 1,3-Dichloropropene ...	N/A	mg/L	0.005
trans 1,3-Dichloropropene .	N/A	mg/L	0.005
Ethylbenzene	0.022	mg/L	0.005
Hexachlorobutadiene	N/A	mg/L	0.005
Isoproylbenzene	N/A	mg/L	0.005
4-Isopropyltoluene	N/A	mg/L	0.005
Dichloromethane	N/A	mg/L	0.005
Napthalene	N/A	mg/L	0.005
Propylbenzene	N/A	mg/L	0.005
Styrene	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethane .	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethene (Tetrachloroethylene)	< 0.005	mg/L	0.005
1,1,1,2-Tetrachloroethane .	N/A	mg/L	0.005
Toluene	0.090	mg/L	0.005
1,2,3-Trichlorobenzene	N/A	mg/L	0.005
1,2,4-Trichlorobenzene	N/A	mg/L	0.005
1,1,1-Trichloroethane	N/A	mg/L	0.005
1,1,2-Trichloroethane	N/A	mg/L	0.005
Trichloroethene (TCE)	N/A	mg/L	0.005
Fluorotrichloromethane	N/A	mg/L	0.005
1,2,3-Trichloropropane	N/A	mg/L	0.005
1,2,4-Trimethylbenzene	N/A	mg/L	0.005
1,3,5-Trimethylbenzene	N/A	mg/L	0.005
Vinyl chloride	N/A	mg/L	0.005
p-m-Xylene	0.068	mg/L	0.005
o-Xylene	0.036	mg/L	0.005

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT: James M. Montgomery
4525 S. Wasatch Blvd.
SLC, Utah 84124

Attn: David A. Fulton

PROJECT NO. : 92-1016
SAMPLE NO. : 131
REPORT DATE : 10/09/92
REVIEWED BY : RAK
PAGE : 1 OF 2

CLIENT ID NO. : None
SAMPLE MATRIX : Ground Water
SAMPLED BY : NKT/RAK
SAMPLE SOURCE : TP-36
ANALYST : NKT

AUTHORIZED BY : DAF
CLIENT P.O. : None
SAMPLE DATE : 08/13/92
SUBMITTAL DATE: 08/13/92
ANALYSIS DATE : 08/13/92

Organic Monitoring-Drinking Water Volatiles
Full Suite

Sample Analysis			
Parameter	Result	Unit	Detection Level
Benzene	< 0.005	mg/L	0.005
Bromobenzene	N/A	mg/L	0.005
Bromochloromethane	N/A	mg/L	0.005
Bromodichloromethane	N/A	mg/L	0.005
Bromoform	N/A	mg/L	0.005
Bromomethane	N/A	mg/L	0.005
n-Butylbenzene	N/A	mg/L	0.005
sec-Butylbenzene	N/A	mg/L	0.005
tert-Butylbenzene	N/A	mg/L	0.005
Carbon tetrachloride	N/A	mg/L	0.005
Chlorobenzene	N/A	mg/L	0.005
Chloroethane	N/A	mg/L	0.005
Chloroform	N/A	mg/L	0.005
Chloromethane	N/A	mg/L	0.005
2-Chlorotoluene (ortho) ...	N/A	mg/L	0.005
4-Chlorotoluene (para)	N/A	mg/L	0.005
1,2-Dibromoethane (EDB) ...	N/A	mg/L	0.005
1,2-Dibromo-3-chloropropane	N/A	mg/L	0.005
Dibromochloromethane	N/A	mg/L	0.005
Dibromomethane	N/A	mg/L	0.005
1,2-Dichlorobenzene (ortho)	N/A	mg/L	0.005
1,3-Dichlorobenzene (meta)	N/A	mg/L	0.005
1,4-Dichlorobenzene (para)	N/A	mg/L	0.005
Dichlorodifluoromethane ...	N/A	mg/L	0.005
1,1-Dichloroethane	N/A	mg/L	0.005
1,2-Dichloroethane	N/A	mg/L	0.005

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT: James M. Montgomery
4525 S. Wasatch Blvd.
SLC, Utah 84124

SAMPLE SOURCE: TP-36

PROJECT NO. : 92-1016
SAMPLE NO. : 131
REPORT DATE : 10/09/92
REVIEWED BY : RAK
PAGE : 2 OF 2

Sample Analysis

Parameter	Result	Unit	Detection Level
cis 1,2-Dichloroethene	N/A	mg/L	0.005
trans 1,2-Dichloroethene ..	N/A	mg/L	0.005
1,2-Dichloropropane	N/A	mg/L	0.005
1,3-Dichloropropane	N/A	mg/L	0.005
2,2-Dichloropropane	N/A	mg/L	0.005
1,1-Dichloropropene	N/A	mg/L	0.005
1,1-Dichloroethene	N/A	mg/L	0.005
cis 1,3-Dichloropropene ...	N/A	mg/L	0.005
trans 1,3-Dichloropropene .	N/A	mg/L	0.005
Ethylbenzene	< 0.005	mg/L	0.005
Hexachlorobutadiene	N/A	mg/L	0.005
Isoproylbenzene	N/A	mg/L	0.005
4-Isopropyltoluene	N/A	mg/L	0.005
Dichloromethane	N/A	mg/L	0.005
Napthalene	N/A	mg/L	0.005
Propylbenzene	N/A	mg/L	0.005
Styrene	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethane .	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethene (Tetrachloroethylene)	< 0.005	mg/L	0.005
1,1,1,2-Tetrachloroethane .	N/A	mg/L	0.005
Toluene	< 0.005	mg/L	0.005
1,2,3-Trichlorobenzene	N/A	mg/L	0.005
1,2,4-Trichlorobenzene	N/A	mg/L	0.005
1,1,1-Trichloroethane	N/A	mg/L	0.005
1,1,2-Trichloroethane	N/A	mg/L	0.005
Trichloroethene (TCE)	N/A	mg/L	0.005
Fluorotrichloromethane	N/A	mg/L	0.005
1,2,3-Trichloropropane	N/A	mg/L	0.005
1,2,4-Trimethylbenzene	N/A	mg/L	0.005
1,3,5-Trimethylbenzene	N/A	mg/L	0.005
Vinyl chloride	N/A	mg/L	0.005
p-m-Xylene	0.052	mg/L	0.005
o-Xylene	< 0.005	mg/L	0.005

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT: James M. Montgomery
4525 S. Wasatch Blvd.
SLC, Utah 84124

Attn: David A. Fulton

PROJECT NO. : 92-1016
SAMPLE NO. : 130
REPORT DATE : 10/09/92
REVIEWED BY : RAK

CLIENT ID NO. : None
SAMPLE MATRIX : Ground Water
SAMPLED BY : NKT/RAK
SAMPLE SOURCE : TP-37
ANALYST : NKT

AUTHORIZED BY : DAF
CLIENT P.O. : None
SAMPLE DATE : 08/13/92
SUBMITTAL DATE: 08/13/92
ANALYSIS DATE : 08/13/92

Organic Monitoring-Drinking Water Volatiles
Full Suite

Sample Analysis

Parameter	Result	Unit	Detection Level
Benzene	0.789	mg/L	0.005
Bromobenzene	N/A	mg/L	0.005
Bromochloromethane	N/A	mg/L	0.005
Bromodichloromethane	N/A	mg/L	0.005
Bromoform	N/A	mg/L	0.005
Bromomethane	N/A	mg/L	0.005
n-Butylbenzene	N/A	mg/L	0.005
sec-Butylbenzene	N/A	mg/L	0.005
tert-Butylbenzene	N/A	mg/L	0.005
Carbon tetrachloride	N/A	mg/L	0.005
Chlorobenzene	N/A	mg/L	0.005
Chloroethane	N/A	mg/L	0.005
Chloroform	N/A	mg/L	0.005
Chloromethane	N/A	mg/L	0.005
2-Chlorotoluene (ortho) ...	N/A	mg/L	0.005
4-Chlorotoluene (para)	N/A	mg/L	0.005
1,2-Dibromoethane (EDB) ...	N/A	mg/L	0.005
1,2-Dibromo-3-chloropropane	N/A	mg/L	0.005
Dibromochloromethane	N/A	mg/L	0.005
Dibromomethane	N/A	mg/L	0.005
1,2-Dichlorobenzene (ortho)	N/A	mg/L	0.005
1,3-Dichlorobenzene (meta)	N/A	mg/L	0.005
1,4-Dichlorobenzene (para)	N/A	mg/L	0.005
Dichlorodifluoromethane ...	N/A	mg/L	0.005
1,1-Dichloroethane	N/A	mg/L	0.005
1,2-Dichloroethane	N/A	mg/L	0.005

TERRA TECHNOLOGIES - SOUTHWEST, INC.
ANALYTICAL TESTING SERVICES

CLIENT: James M. Montgomery
4525 S. Wasatch Blvd.
SLC, Utah 84124

SAMPLE SOURCE: TP-37

PROJECT NO. : 92-1016
SAMPLE NO. : 130
REPORT DATE : 10/09/92
REVIEWED BY : RAK

Sample Analysis

Parameter	Result	Unit	Detection Level
cis 1,2-Dichloroethene	N/A	mg/L	0.005
trans 1,2-Dichloroethene ..	N/A	mg/L	0.005
1,2-Dichloropropane	N/A	mg/L	0.005
1,3-Dichloropropane	N/A	mg/L	0.005
2,2-Dichloropropane	N/A	mg/L	0.005
1,1-Dichloropropene	N/A	mg/L	0.005
1,1-Dichloroethene	N/A	mg/L	0.005
cis 1,3-Dichloropropene ...	N/A	mg/L	0.005
trans 1,3-Dichloropropene .	N/A	mg/L	0.005
Ethylbenzene	< 0.005	mg/L	0.005
Hexachlorobutadiene	N/A	mg/L	0.005
Isoproylbenzene	N/A	mg/L	0.005
4-Isopropyltoluene	N/A	mg/L	0.005
Dichloromethane	N/A	mg/L	0.005
Napthalene	N/A	mg/L	0.005
Propylbenzene	N/A	mg/L	0.005
Styrene	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethane .	N/A	mg/L	0.005
1,1,2,2-Tetrachloroethene (Tetrachloroethylene)	2.525	mg/L	0.005
1,1,1,2-Tetrachloroethane .	N/A	mg/L	0.005
Toluene	0.930	mg/L	0.005
1,2,3-Trichlorobenzene	N/A	mg/L	0.005
1,2,4-Trichlorobenzene	N/A	mg/L	0.005
1,1,1-Trichloroethane	N/A	mg/L	0.005
1,1,2-Trichloroethane	N/A	mg/L	0.005
Trichloroethene (TCE)	N/A	mg/L	0.005
Fluorotrichloromethane	N/A	mg/L	0.005
1,2,3-Trichloropropane	N/A	mg/L	0.005
1,2,4-Trimethylbenzene	N/A	mg/L	0.005
1,3,5-Trimethylbenzene	N/A	mg/L	0.005
Vinyl chloride	N/A	mg/L	0.005
p-m-Xylene	2.410	mg/L	0.005
o-Xylene	1.769	mg/L	0.005

Analytical Report

Mountain States Analytical

The Quality Solution

CLIENT:	J.M. Montgomery Engineers 4525 So. Wasatch #200 Salt Lake City, UT 84124-	SAMPLE NO:	0001527
		SAMPLE SET NO:	000297S
		DATE SAMPLED:	11/24/92
		TIME SAMPLED:	800
ATTN:	Mr. Robert Glascot	DATE RECEIVED:	11/25/92
		DATE REPORTED:	12/10/92
SAMPLE ID:	MW-40	DISPOSAL DATE:	01/09/93

ANALYSIS: Volatiles - Water Matrix [EPA 601/602] (Capillary)

COMPOUND(s)		RESULT	LIMIT OF QUANTITATION
Chloromethane	<	2.0 ug/l	2.0 ug/l
Vinyl Chloride	<	2.0 ug/l	2.0 ug/l
Bromomethane	<	2.0 ug/l	2.0 ug/l
Chloroethane	<	2.0 ug/l	2.0 ug/l
Fluorotrichloromethane	<	2.0 ug/l	2.0 ug/l
1,1-Dichloroethene	<	1.0 ug/l	1.0 ug/l
Dichloromethane	<	1.0 ug/l	1.0 ug/l
trans-1,2-Dichloroethene	<	1.0 ug/l	1.0 ug/l
1,1-Dichloroethane	<	1.0 ug/l	1.0 ug/l
Chloroform	<	1.0 ug/l	1.0 ug/l
1,1,1-Trichloroethane	<	1.0 ug/l	1.0 ug/l
Carbon Tetrachloride	<	1.0 ug/l	1.0 ug/l
Benzene		6.5 ug/l	1.0 ug/l
1,2-Dichloroethane	<	1.0 ug/l	1.0 ug/l
Trichloroethene (TCE)	<	1.0 ug/l	1.0 ug/l
1,2-Dichloropropane	<	1.0 ug/l	1.0 ug/l
Bromodichloromethane	<	1.0 ug/l	1.0 ug/l
cis-1,3-Dichloropropene	<	1.0 ug/l	1.0 ug/l
trans-1,3-Dichloropropene	<	1.0 ug/l	1.0 ug/l
Toluene		7.8 ug/l	1.0 ug/l
Tetrachloroethene (PCE)	<	1.0 ug/l	1.0 ug/l
Chlorodibromomethane	<	1.0 ug/l	1.0 ug/l
Chlorobenzene	<	1.0 ug/l	1.0 ug/l
Ethylbenzene		1.7 ug/l	1.0 ug/l
Bromoform	<	2.0 ug/l	2.0 ug/l
m,p-Xylene		12.2 ug/l	1.0 ug/l
o-Xylene/Styrene*		3.4 ug/l	1.0 ug/l

-Continued-

ENGINEERING-SCIENCE, INC.

Awareness Quality Improvement Process

this one has been noted as tables as dup of 870-WS-2/49

Mountain States Analytical

The Quality Solution

James M. Montgomery Engineers
4525 South Wasatch Blvd., Suite 200
Salt Lake City, UT 84124
Telephone: (801) 272-1900
Facsimile: (801) 272-0403

Sample Number: 0001527
Sample Set: 000297S
Date Reported: 10 DEC 1992
Date Received: 25 NOV 1992
Disposal Date: 8 JAN 1993

Attention: Robert Glascot
Project: HAFB USTs
Case Number: VOCs/BTEXN
Purchase Order: 2208.0585

Customer Number: MW-40
Date Sampled: 24 NOV 1992
Matrix: Water/Waste Water
Containers: 3

Analysis	Catalog Number	Method	Result	Dry Result	Reporting Units
Volatile Aromatics/Halocarbons	05515	EPA 600 Series 601/602	See Attached		

1 Analysis for GC

Reviewed and approved by
Kenneth Roberts, B.S.
GC Group Leader

1 Analysis for Sample Number 0001527

Mountain States Analytical

The Quality Solution

CLIENT: J.M. Montgomery Engineers
4525 S Wasatch #200
Salt Lake City, UT 84124

ATTN: Mr. David Fulton

SAMPLE ID: Trip Blank

LAB NO: 34828
GROUP NO: 8810
DATE SAMPLED: 10/01/92
TIME SAMPLED: 0
DATE RECEIVED: 10/02/92
DATE REPORTED: 10/16/92
DISPOSAL DATE: 11/15/92
ANALYSIS DATE: 10/12/92

ANALYSIS: Priority Pollutants by GCMS (Volatiles)
EPA Method SW-846 8240

COMPOUNDS	FINAL RESULTS	QUANTITATION LIMIT
Chloromethane	<10 ug/l	10 ug/l
Vinyl Chloride	<10 ug/l	10 ug/l
Bromomethane	<10 ug/l	10 ug/l
Chloroethane	<10 ug/l	10 ug/l
Trichlorofluoromethane	<5 ug/l	5 ug/l
Acrolein	<100 ug/l	100 ug/l
1,1-Dichloroethene	<5 ug/l	5 ug/l
Methylene Chloride	<5 ug/l	5 ug/l
Acrylonitrile	<100 ug/l	100 ug/l
1,1-Dichloroethane	<5 ug/l	5 ug/l
1,2-Dichloroethene (total)	<5 ug/l	5 ug/l
Chloroform	<5 ug/l	5 ug/l
1,1,1-Trichloroethane	<5 ug/l	5 ug/l
Carbon Tetrachloride	<5 ug/l	5 ug/l
Benzene	<5 ug/l	5 ug/l
1,2-Dichloroethane	<5 ug/l	5 ug/l
Trichloroethene	<5 ug/l	5 ug/l
1,2-Dichloropropane	<5 ug/l	5 ug/l
Bromodichloromethane	<5 ug/l	5 ug/l
2-Chloroethylvinyl ether	<10 ug/l	10 ug/l
cis-1,3-Dichloropropene	<5 ug/l	5 ug/l
Toluene	<5 ug/l	5 ug/l
trans-1,3-Dichloropropene	<5 ug/l	5 ug/l
1,1,2-Trichloroethane	<5 ug/l	5 ug/l
Tetrachloroethene	<5 ug/l	5 ug/l
Dibromochloromethane	<5 ug/l	5 ug/l
Chlorobenzene	<5 ug/l	5 ug/l
Ethylbenzene	<5 ug/l	5 ug/l
Xylenes (Total)	<5 ug/l	5 ug/l
Bromoform	<5 ug/l	5 ug/l
1,1,2,2-Tetrachloroethane	<5 ug/l	5 ug/l

Respectfully submitted,

John G. Hayes

John G. Hayes, B.S.
Supervisor, GCMS Group

MONTGOMERY LABORATORIES

CHAIN OF CUSTODY RECORD

PROJECT/JOB #: 2208 0402

PROJECT NAME: HAFB UST Site 870

SAMPLERS: (Signature) [signature] (RAG)

ANALYSIS (USE 1 COLUMN PER BOTTLE): VOAs 601/602

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS	VOAs 601/602									REMARKS
	9/30/92	1000		✓	CPT-7	2	✓*									* Note this sample may contain
	9/30/92	1320		✓	T-870-5-MW-U-92-HF	2	✓									free product (NAPL)
	9/30/92	1100		✓	T-870-27-MW-11-92-HF	2	✓									
	9/30/92	1325		✓	T-870-11-MW-U-92-HF	2	✓									
	10/1/92	1200		✓	T-870-12-MW-U-92-HF	2	✓									
	10/1/92	1500		✓	T-870-10-MW-U-92-HF	2	✓									
					Trip Blank 9/30-10/1	2	✓									

RELINQUISHED BY: (SIGNATURE)	DATE / TIME	RECEIVED BY: (SIGNATURE)	RELINQUISHED BY: (SIGNATURE)	DATE / TIME	RECEIVED BY: (SIGNATURE)
[signature]	10/1/92 1745	[signature]			
RELINQUISHED BY: (SIGNATURE)	DATE / TIME	RECEIVED BY: (SIGNATURE)	RELINQUISHED BY: (SIGNATURE)	DATE / TIME	RECEIVED BY: (SIGNATURE)

RELINQUISHED BY: (SIGNATURE)	DATE / TIME	RECEIVED FOR LABORATORY BY: (SIGNATURE)	DATE / TIME	REMARKS

Amenco

October 28, 1993

Engineering Science
Todd Wiedemeier
700 Broadway, Suite 900
Denver, CO 80290

Dear Todd:

Enclosed is the sample identification and PID results for the Hill AFB project. John Wilson suggested that I send you a copy. I look forward to hearing from you soon. Call me if you have any questions.

Sincerely yours,

Lonnie G. Kennedy

Hill AFB
EPA Soil Sampling
Sample ID, Depth, and PID Reference

EPA Lab Sample ID	Depth ft. Top	Depth ft. Bottom	Sample Thickness (Feet)	PID (ppm) No Sample
NS	11.00	12.00	1.00	6
NS	12.00	13.00	1.00	18
NS	13.00	14.00	1.00	0
NS	14.00	15.00	1.00	4
NS	15.00	16.00	1.00	0
NS	16.00	17.00	1.00	4
NS	17.00	18.00	1.00	9
NS	18.00	18.75	0.75	1
82-A 16	18.75	19.00	0.25	3
82-A 15	19.00	19.25	0.25	4
82-A 14	19.25	19.50	0.25	NS
82-A 13	19.50	19.75	0.25	NS
82-A 12	19.75	20.00	0.25	3
82-A 11	20.00	20.25	0.25	6
82-A 10	20.25	20.50	0.25	NS
82-A 9	20.50	20.75	0.25	9
82-A 8	20.75	21.00	0.25	3
82-A 7	21.00	21.25	0.25	3
82-A 6	21.25	21.50	0.25	3
82-A 5	21.50	21.75	0.25	3
82-A 4	21.75	22.00	0.25	3
82-A 3	22.00	22.25	0.25	2
82-A 2	22.25	22.50	0.25	2
82-A 1	22.50	22.75	0.25	2
82-A 25	22.75	23.00	0.25	>1000
82-A 24	23.00	23.40	0.40	132
82-A 23	23.40	23.80	0.40	56
82-A 22	23.80	24.20	0.40	56
82-A 21	24.20	24.60	0.40	35
82-A 20	24.60	25.00	0.40	6
82-A 19	25.00	25.40	0.40	2
82-A 18	25.40	25.80	0.40	2
82-A 17	25.80	26.20	0.40	2
82-A 16	26.20	26.60	0.40	2
82-A 15	26.60	27.00	0.40	2
82-A 41	27.00	27.30	0.30	2
82-A 40	27.30	27.60	0.30	1
82-A 39	27.60	27.90	0.30	2
82-A 38	27.90	28.20	0.30	1
82-A 37	28.20	28.50	0.30	5
82-A 36	28.50	28.80	0.30	8
82-A 35	28.80	29.10	0.30	2
82-A 34	29.10	29.40	0.30	5
82-A 33	29.40	29.70	0.30	8
82-A 32	29.70	30.00	0.30	4
82-A 31	30.00	30.30	0.30	5
82-A 30	30.30	30.60	0.30	6
82-A 29	30.60	30.90	0.30	9
82-A 28	30.90	31.20	0.30	5

Hill AFB
EPA Soil Sampling
Sample ID, Depth, and PID Reference

EPA Lab Sample ID	Depth ft. Top	Depth ft. Bottom	Sample Thickness (Feet)	PID (ppm) No Sample
82-A 27	31.20	31.50	0.30	5
82-A 54	31.50	31.80	0.30	2
82-A 53	31.80	32.10	0.30	2
82-A 52	32.10	32.40	0.30	5
82-A 51	32.40	32.70	0.30	8
82-A 50	32.70	33.00	0.30	6
82-A 49	33.00	33.30	0.30	8
82-A 48	33.30	33.60	0.30	6
82-A 47	33.60	33.90	0.30	4
82-A 46	33.90	34.20	0.30	9
82-A 45	34.20	34.50	0.30	10
82-A 44	34.50	34.80	0.30	8
82-A 43	34.80	35.10	0.30	3
82-A 42	35.10	35.40	0.30	3

Hill AFB
EPA Soil Sampling
Sample ID, Depth, and PID Reference

EPA Lab Sample ID	Depth ft. Top	Depth ft. Bottom	Sample Thickness (Feet)	PID (ppm) No Sample
NS	0.00	1.00	1.00	2
NS	1.00	2.00	1.00	2
NS	2.00	3.00	1.00	2
NS	3.00	4.00	1.00	2
NS	4.00	5.00	1.00	1
NS	5.00	6.00	1.00	2
NS	6.00	7.00	1.00	2
NS	7.00	8.00	1.00	2
NS	8.00	9.00	1.00	
NS	9.00	10.00	1.00	2
NS	10.00	11.00	1.00	2
NS	11.00	12.00	1.00	2
NS	12.00	13.00	1.00	2
NS	13.00	14.00	1.00	3
NS	14.00	15.00	1.00	
NS	15.00	16.00	1.00	2
NS	16.00	17.00	1.00	0
NS	17.00	18.00	1.00	0
NS	18.00	19.00	1.00	0
NS	19.00	20.00	1.00	
82B 12	20.00	20.30	0.30	2
82B 11	20.30	20.60	0.30	2
82B 10	20.60	20.90	0.30	3
82B 9	20.90	21.20	0.30	2
82B 8	21.20	21.50	0.30	1
82B 7	21.50	21.80	0.30	1
82B 6	21.80	22.10	0.30	1
82B 5	22.10	22.40	0.30	1
82B 4	22.40	22.70	0.30	1
82B 2	22.70	23.00	0.30	1
82B 1	23.00	23.30	0.30	1
NS	23.30	23.60	0.30	NS
NS	23.60	23.90	0.30	NS
82B 24	23.90	24.10	0.20	2
82B 23	24.10	24.40	0.30	2
82B 22	24.40	24.70	0.30	2
82B 21	24.70	25.00	0.30	2
82B 20	25.00	25.30	0.30	2
82B 19	25.30	25.60	0.30	2
82B 18	25.60	25.90	0.30	2
82B 17	25.90	26.10	0.20	2
82B 16	26.10	26.40	0.30	2
82B 15	26.40	26.70	0.30	2
82B 14	26.70	27.10	0.40	2
82B 13	27.10	27.40	0.30	2
NS	27.40	27.80	0.40	NS

Hill AFB
EPA Soil Sampling
Sample ID, Depth, and PID Reference

EPA Lab Sample ID	Depth ft. Top	Depth ft. Bottom	Sample Thickness (Feet)	PID (ppm) No Sample
NS	0.00	1.00	1.00	0
NS	1.00	2.00	1.00	0
NS	2.00	3.00	1.00	0
NS	3.00	4.00	1.00	0
NS	4.00	5.00	1.00	6
NS	5.00	6.00	1.00	26
NS	6.00	7.00	1.00	31
NS	7.00	8.00	1.00	21
NS	8.00	9.00	1.00	11
NS	9.00	10.00	1.00	11
NS	10.00	11.00	1.00	14
NS	11.00	12.00	1.00	3
NS	12.00	13.00	1.00	1
82-C 2	13.00	13.60	0.60	NS
82-C 1	13.60	13.90	0.30	NS
82-C NS	13.90	14.10	0.20	NS
82-C NS	14.10	14.40	0.30	NS
82-C NS	14.40	14.80	0.40	NS
82-C NS	14.80	15.10	0.30	NS
82-C 12	15.10	15.40	0.30	1
82-C 11	15.40	15.70	0.30	1
82-C 10	15.70	16.00	0.30	1
82-C 9	16.00	16.30	0.30	1
82-C 8	16.30	16.60	0.30	1
82-C 7	16.60	16.90	0.30	1
82-C 6	16.90	17.20	0.30	1
82-C 5	17.20	17.50	0.30	1
82-C 4	17.50	17.80	0.30	NS
82-C 3	17.80	18.10	0.30	NS
82-C NS	18.10	18.40	0.30	NS
82-C NS	18.40	18.70	0.30	NS
82-C NS	18.70	19.00	0.30	NS
82-C NS	19.00	19.30	0.30	NS
82-C NS	19.30	19.60	0.30	NS
82-C NS	19.60	19.90	0.30	NS
82-C 26	19.90	20.20	0.30	4
82-C 25	20.20	20.50	0.30	20
82-C 24	20.50	20.80	0.30	26
82-C 23	20.80	21.10	0.30	162
82-C 22	21.10	21.40	0.30	297
82-C 21	21.40	21.55	0.15	273
82-C 20	21.55	21.70	0.15	287
82-C 19	21.70	22.00	0.30	314
82-C 18	NS	NS	0.00	NS
82-C 17	22.00	22.10	0.10	182
82-C 16	22.10	22.30	0.20	27
82-C 15	NS	NS	0.00	NS
82-C 14	22.30	22.60	0.30	12
82-C 13	22.60	22.90	0.30	4

Hill AFB
EPA Soil Sampling
Sample ID, Depth, and PID Reference

EPA Lab Sample ID	Depth ft. Top	Depth ft. Bottom	Sample Thickness (Feet)	PID (ppm) No Sample
82-C NS	22.90	23.20	0.30	NS
82-C NS	23.20	23.50	0.30	NS
82-C NS	23.50	23.80	0.30	NS
82-C NS	23.80	24.10	0.30	NS

Hill AFB
EPA Soil Sampling
Sample ID, Depth, and PID Reference

EPA Lab Sample ID	Depth ft. Top	Depth ft. Bottom	Sample Thickness (Feet)	PID (ppm) No Sample
NS	0.00	1.00	1.00	0
NS	1.00	2.00	1.00	0
NS	2.00	3.00	1.00	0
NS	3.00	4.00	1.00	0
NS	4.00	5.00	1.00	0
NS	5.00	6.00	1.00	0
NS	6.00	7.00	1.00	0
NS	7.00	8.00	1.00	0
NS	8.00	9.00	1.00	0
NS	9.00	10.00	1.00	0
NS	10.00	11.00	1.00	0
NS	11.00	12.00	1.00	0
NS	12.00	13.00	1.00	0
NS	13.00	14.00	1.00	0
NS	14.00	15.00	1.00	0
NS	15.00	16.00	1.00	0
NS	16.00	17.00	1.00	0
NS	17.00	18.00	1.00	0
NS	18.00	19.00	1.00	0
NS	19.00	20.00	1.00	NS
82-D 11	20.00	20.30	0.30	0
82-D 10	20.30	20.60	0.30	0
82-D 9	20.60	20.90	0.30	1
82-D 8	20.90	21.20	0.30	1
82-D 7	21.20	21.50	0.30	1
82-D 6	21.50	21.80	0.30	1
82-D 5	21.80	22.10	0.30	1
82-D 4	22.10	22.40	0.30	199
82-D 3	22.40	22.80	0.40	17
82-D 2	22.80	23.80	1.00	3
82-D 1	23.80	24.00	0.20	2
82-D 25	24.00	24.10	0.10	25
82-D 24	24.10	24.40	0.30	50
82-D 23	24.40	24.70	0.30	282
82-D 22	24.70	25.00	0.30	63
82-D 21	25.00	25.30	0.30	30
82-D 20	25.30	25.60	0.30	16
82-D 19	25.60	25.90	0.30	29
82-D 18	25.90	26.20	0.30	11
82-D 17	26.20	26.50	0.30	15
82-D 16	26.50	26.80	0.30	20
82-D 15	26.80	27.00	0.20	27
82-D 14	27.00	27.30	0.30	20
82-D 13	27.30	27.60	0.30	25
82-D 12	27.60	27.80	0.20	15
82-D NS	27.80	28.00	0.20	NS
82-D 40	28.00	28.20	0.20	8
82-D 39	28.20	28.50	0.30	20
82-D 38	28.50	28.80	0.30	12

Hill AFB
EPA Soil Sampling
Sample ID, Depth, and PID Reference

EPA Lab Sample ID	Depth ft. Top	Depth ft. Bottom	Sample Thickness (Feet)	PID (ppm) No Sample
82-D 37	28.80	29.10	0.30	41
82-D 36	29.10	29.40	0.30	42
82-D 35	29.40	29.70	0.30	26
82-D 34	29.70	30.00	0.30	11
82-D 33	30.00	30.30	0.30	33
82-D 32	30.30	30.60	0.30	20
82-D 31	30.60	30.90	0.30	13
82-D 30	30.90	31.20	0.30	11
82-D 29	31.20	31.50	0.30	9
82-D 28	31.50	31.80	0.30	4
82-D 27	31.80	32.10	0.30	1
82-D 26	32.10	32.40	0.30	3

Hill AFB
EPA Soil Sampling
Sample ID, Depth, and PID Reference

EPA Lab Sample ID	Depth ft. Top	Depth ft. Bottom	Sample Thickness (Feet)	PID (ppm) No Sample
82-E NS	0.00	0.30	0.30	
82-E 11	0.30	0.60	0.30	3.0
82-E 10	0.60	0.90	0.30	1.0
82-E 9	0.90	1.20	0.30	1.0
82-E 8	1.20	1.50	0.30	1.0
82-E 7	1.50	1.80	0.30	1.0
82-E 6	1.80	2.10	0.30	1.0
82-E 5	2.10	2.40	0.30	1.0
82-E 4	2.40	2.70	0.30	1.0
82-E 3	2.70	3.00	0.30	1.0
82-E 2	3.00	3.30	0.30	1.0
82-E 1	3.30	3.50	0.20	1.0
82-E 21	3.50	3.85	0.35	1.0
82-E 20	3.85	4.20	0.35	1.0
82-E 19	4.20	4.55	0.35	1.0
82-E 18	4.55	4.90	0.35	1.0
82-E 17	4.90	5.25	0.35	1.0
82-E 16	5.25	5.60	0.35	1.0
82-E 15	5.60	5.95	0.35	1.0
82-E 14	5.95	6.30	0.35	1.0
82-E 13	6.30	6.65	0.35	1.0
82-E 12	6.65	7.00	0.35	1.0
82-E 32	7.00	7.31	0.31	1.0
82-E 31	7.31	7.64	0.33	2.0
82-E 30	7.64	7.95	0.31	3.0
82-E 29	7.95	8.27	0.32	3.0
82-E 28	8.27	8.59	0.32	3.0
82-E 27	8.59	8.91	0.32	2.0
82-E 26	8.91	9.55	0.64	1.0
82-E 25	9.55	9.86	0.31	1.5
82-E 24	9.86	10.18	0.32	1.0
82-E 23	10.18	10.50	0.32	1.0

Hill AFB
EPA Soil Sampling
Sample ID, Depth, and PID Reference

EPA Lab Sample ID	Depth ft. Top	Depth ft. Bottom	Sample Thicknes (Feet)	PID (ppm No Samp
82-I NS	0.00	1.00	1.00	NS
82-I NS	1.00	2.00	1.00	0.0
82-I NS	2.00	3.00	1.00	0.0
82-I NS	3.00	4.00	1.00	1.0
82-I NS	4.00	5.00	1.00	1.0
82-I NS	5.00	6.00	1.00	1.0
82-I NS	6.00	7.00	1.00	1.0
82-I NS	7.00	8.00	1.00	1.0
82-I NS	8.00	9.00	1.00	2.0
82-I NS	9.00	10.00	1.00	3.0
82-I NS	10.00	11.00	1.00	2.0
82-I NS	11.00	12.00	1.00	3.0
82-I NS	12.00	13.00	1.00	3.0
82-I NS	13.00	13.80	0.80	2.0
82-I 14	13.80	14.00	0.20	3.0
82-I 13	14.00	14.40	0.40	3.0
82-I 12	14.40	14.80	0.40	2.0
82-I 11	14.80	15.20	0.40	0.0
82-I 10	15.20	15.56	0.36	4.0
82-I 9	15.56	15.92	0.36	4.0
82-I 8	15.92	16.28	0.36	6.0
82-I 7	16.28	16.64	0.36	13.0
82-I 6	16.64	17.00	0.36	81.0
82-I 5	17.00	17.36	0.36	257.0
82-I 4	17.36	17.72	0.36	181.0
82-I 3	17.72	18.08	0.36	137.0
82-I 2	18.08	18.44	0.36	150.0
82-I 1	18.44	18.80	0.36	143.0
82-I 27	18.80	19.12	0.32	397.0
82-I 26	19.12	19.45	0.33	301.0
82-I 25	19.45	19.77	0.32	136.0
82-I 24	19.77	20.09	0.32	176.0
82-I 23	20.09	20.42	0.33	78.0
82-I 22	20.42	20.74	0.32	87.0
82-I 21	20.74	21.06	0.32	79.0
82-I 20	21.06	21.38	0.32	95.0
82-I 19	21.38	21.71	0.33	103.0
82-I 18	21.71	22.03	0.32	298.0
82-I 17	22.03	22.35	0.32	357.0
82-I 16	22.35	22.68	0.33	293.0
82-I 15	22.68	23.00	0.32	270.0
82-I 39	23.00	23.20	0.20	255.0
82-I 38	23.20	23.40	0.20	145.0
82-I 37	23.40	23.76	0.36	330.0
82-I 36	23.76	24.12	0.36	239.0
82-I 35	24.12	24.48	0.36	74.0
82-I 34	24.48	24.84	0.36	68.0
82-I 33	24.84	25.20	0.36	311.0
82-I 32	25.20	25.56	0.36	236.0

Hill AFB
EPA Soil Sampling
Sample ID, Depth, and PID Reference

EPA Lab Sample ID	Depth ft. Top	Depth ft. Bottom	Sample Thicknes (Feet)	PID (ppm No Samp
82-I 31	25.56	25.92	0.36	239.0
82-I 30	25.92	26.28	0.36	252.0
82-I 29	26.28	26.64	0.36	26.0
82-I 28	26.64	27.00	0.36	13.0

DATA CHEM
LABORATORIES

ANALYTICAL REPORT

Form ARF-AL
Page 1 of 2
Part 1 of 1

Date 6-30-92
Agency Identification Number S[illegible]-0429-BB
Account No. 03018

James M. Montgomery Consulting Engineers
4525 Wasatch Blvd, Suite 200
Salt Lake City, UT 84124
Attention: Bob Glascott

FAX (801) 272-0430
Telephone (801) 272-1900

Sampling Collection and Shipment

Sampling Site HAFB   Date of Collection June 18, 1992

Date Samples Received at Laboratory June 19, 1992

Analysis

Method of Analysis 8020MOD

Date(s) of Analysis June 23, 1992 - June 24, 1992

Analytical Results

Field Sample Number	Laboratory Number	Sample Type	Benzene UG/G	Ethyl Benzene UG/G	Toluene UG/G	Xylene UG/G	Naphthalene UG/G			
HF '11-11.5'	EL 2419	SOIL	ND*	0.12	.031	.92	4.4			
* Limit of Detection			.005	.005	.005	.01	.01			

* See comment on last page.
ND Parameter not detected.
NP Parameter not requested.
** See comment on last page.
( ) Parameter between LOD and LOQ.

Analyst: Arthur B. Clarke

Reviewer:

Laboratory Supervisor: Richard W. Wade

960 West LeVoy Drive / Salt Lake City, Utah 84123-2547 / (801) 266-7700
A Sorenson Company

DATA CHEM LABORATORIES

ANALYTICAL REPORT

Date ______
Agency Identification Number S92-0429-AB
Account No. 03018

James M. Montgomery Consulting Engineers
4525 Wasatch Blvd, Suite 200
Salt Lake City, UT 84124
Attention: Bob Glascott

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Telephone (801) 272-1900

Sampling Collection and Shipment

Sampling Site HAFB Date of Collection June 18, 1992

Date Samples Received at Laboratory June 19, 1992

Analysis

Method of Analysis DCL-TPHD

Date(s) of Analysis June 27, 1992

Analytical Results

Field Sample Number	Laboratory Number	Sample Type	TPH-Jet Fuel mg/g							
HF/11-11.5'	EL 2419	SOIL	0.11							
Limit of Detection			0.01							

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.
** See comment on last page.
( ) Parameter between LOD and LOQ.

Analyst: Laurence E. Miller

Reviewer:

Laboratory Supervisor:

DATA CHEM LABORATORIES

ANALYTICAL REPORT

Form ARF-AL

Date 7-28-92
Agency Identification Number S92-0517-BC
Account No. 03018

James M. Montgomery Consulting Engineers
4525 Wasatch Blvd, Suite 200
Salt Lake City, UT 84124
Attention: Bob Glascott

FAX (801) 272-0430
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Sampling Collection and Shipment

Sampling Site HAFB Date of Collection June 29, 1992

Date Samples Received at Laboratory June 30, 1992

Analysis

Method of Analysis 8020MOD

Date(s) of Analysis July 22, 1992

Analytical Results

Field Sample Number	Laboratory Number	Sample Type	Benzene µg/g	Ethyl Benzene µg/g	Toluene µg/g	Xylene µg/g	Naphthalene µg/g			
2HF/17'-17.5	EL 2858	SOIL	.10	.18	.10	5.4	2.9			
7HF/17'-17.5	EL 2859	SOIL	10.	16.	23.	74.	6.6			
Limit of Detection			.005	.005	.005	.01	.01			

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

AUG 5 1992

Analyst: Arthur B. Clarke

Reviewer: Larry Scanlan

Laboratory Supervisor: Richard W. Wade

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DATA CHEM LABORATORIES

ANALYTICAL REPORT

Form ARF-AL
Page 1 of 2
Part 1 of 1

Date 8/3/92
Agency Identification Number S92-0517-AC
Account No. 03018

James M. Montgomery Consulting Engineers
4525 Wasatch Blvd, Suite 200
Salt Lake City, UT 84124
Attention: Bob Glascott

FAX (801) 272-0430
Telephone (801) 272-1900

Sampling Collection and Shipment

Sampling Site HAFB — Date of Collection June 29, 1992

Date Samples Received at Laboratory June 30, 1992

Analysis

Method of Analysis DCL-TPHD

Date(s) of Analysis July 27, 1992

Analytical Results

Field Sample Number	Laboratory Number	Sample Type	TPH-Jet Fuel mg/g								
2HF/17'-17.5	EL 2858	SOIL	0.36								
7HF/17'-17.5	EL 2859	SOIL	1.5								
Limit of Detection			0.01								

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.
** See comment on last page.
( ) Parameter between LOD and LOQ.

Analyst: Lawrence E. Miller
Reviewer:
Laboratory Supervisor:

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A Sorenson Company

DATA CHEM LABORATORIES

ANALYTICAL REPORT

Form ARF-AL
Page 1 of 2
Part 1 of 1

Date 7/2/92
Agency Identification Number S92-0427-AC
Account No. 03018

James M. Montgo... Consulting Engineers
4525 Wasatch Blvd, Suite 200
Salt Lake City, UT 84124
Attention: Bob Glascott

FAX (801) 272-0430
Telephone (801) 272-1900

Sampling Collection and Shipment

Sampling Site HAFB   Date of Collection June 17, 1992

Date Samples Received at Laboratory June 18, 1992

Analysis

Method of Analysis DCL-TPHD

Date(s) of Analysis June 2? 1992

Analytical Results

Field Sample Number	Laboratory Number	Sample Type	TPH-Jet Fuel mg/g							
HF/15.5'-16'	EL 2415	SOIL	0.02							
HF/21'-21.5'	EL 2416	SOIL	ND*							
* Limit of Detection			0.01							

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

RECEIVED
JUL 6 1992
J.M. MONTGOMERY

Analyst: Lawrence E. Miller
Lawrence E. Miller

Reviewer: Dan Bruch

Laboratory Supervisor: Dan Bruch

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DATA CHEM LABORATORIES

ANALYTICAL REPORT

Date 6-25-92
Agency Identification Number S92-0427-BC
Account No. 03018

James M. Montgomery Consulting Engineers
4525 Wasatch Blvd, Suite 200
Salt Lake City, UT 84124
Attention: Bob Glascott

FAX (801) 272-0430
Telephone (801) 272-1900

Sampling Collection and Shipment

Sampling Site HAFB   Date of Collection June 17, 1992

Date Samples Received at Laboratory June 18, 1992

Analysis

Method of Analysis 8020MOD

Date(s) of Analysis June 18, 1992

Analytical Results

Field Sample Number	Laboratory Number	Sample Type	Benzene UG/G	Ethyl Benzene UG/G	Toluene UG/G	Xylene UG/G	Naphthalene UG/G			
HF/15.5'-16'	EL 2415	SOIL	2.0	0.26	0.11	2.8	1.4			
HF/21'-21.5'	EL 2416	SOIL	.009	ND*	ND*	ND*	.05			
* Limit of Detection			.005.	.005.	.005.	.01	.01			

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.
** See comment on last page.
( ) Parameter between LOD and LOQ.

Analyst: Arthur B. Clarke

Reviewer:

Laboratory Supervisor: Richard W. Wade

DATA CHEM LABORATORIES

ANALYTICAL REPORT

Form ARF-AL
Page 1 of 2
Part 1 of 1

Date 7-7-92
Agency Identification Number S92-0453-BB
Account No. 03018

James M. Montgomery Consulting Engineers
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Salt Lake City, UT 84124
Attention: Bob Glascott

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Telephone (801) 272-1900

Sampling Collection and Shipment

Sampling Site HAFB Date of Collection July 01, 1992

Date Samples Received at Laboratory July 02, 1992

Analysis

Method of Analysis 8020MOD

Date(s) of Analysis July 06, 1992

Analytical Results

Field Sample Number	Laboratory Number	Sample Type	Benzene UG/G	Ethyl Benzene UG/G	Toluene UG/G	Xylene UG/G	Naphthalene UG/G			
HF/59.5'-60'	EL 2578	SOIL	ND*	ND*	ND*	ND*	ND*			
* Limit of Detection			.005	.005	.005	.01	.01			

* See comment on last page.
ND Parameter not detected.
NR Parameter not requested.

** See comment on last page.
( ) Parameter between LOD and LOQ.

RECEIVED
JUL 10 1992
JAMES M. MONTGOMERY

Analyst: Arthur B. Clarke

Reviewer: Larry Scanlan

Laboratory Supervisor: Richard W. Wade

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ANALYTICAL REPORT

Date 7/12/92
Agency Identification Number S92-0453-AB
Account No. 03018

James M. Montgomery Consulting Engineers
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Salt Lake City, UT 84124
Attention: Bob Glascott

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Telephone (801) 272-1900

Sampling Collection and Shipment

Sampling Site HAFB Date of Collection July 01, 1992

Date Samples Received at Laboratory July 02, 1992

Analysis

Method of Analysis DCL-TPHD

Date(s) of Analysis

Analytical Results

Field Sample Number	Laboratory Number	Sample Type	TPH-Jet Fuel mg/g							
HF/59.5'-66'	EL 2578	SOIL	ND*							
* Limit of Detection			0.01							

* See comment on last page. ** See comment on last page.
ND Parameter not detected. ( ) Parameter between LOD and LOQ.
NR Parameter not requested.

RECEIVED
JUL 14 1992
JAMES M. MONTGOMERY

Analyst: Lawrence E. Miller
Lawrence E. Miller

Reviewer: Dan Brush

Laboratory Supervisor: Dan Brush

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SOIL ANALYTICAL RESULTS

Well Number	Sample Interval (ft bgs)	Benzene (ug/Kg)	Toluene (ug/Kg)	Ethyl Benzene (ug/Kg)	Xylene (ug/Kg)	TPH (mg/kg)
MW-1	16-17	150	129	57	318	<10.0
MW-1	18-19	564	145	341	2249	98.3
SB870A-02	15-16	43.2	51.3	52.2	457.3	23.2
SB870A-02	17-18	13	60.2	57.7	509	37
SB870A-03	11-12	9400	115000	66700	634000	2790
SB870A-03	19-20	338	595	138	1143	<10.0
SB870A-03*	29-30	22200	187000	83100	744000	15100
MW-5	15.5-16	2000	110	260	2800	20
MW-6	21-21.5	9	<5	<5	<5	<10.0
MW-8	11-11.5	<5	31	120	920	110
MW-9	17-17.5	100	100	180	5400	360
MW-1A**	17-17.5	10000	23000	16000	74000	1500
MW-1A**	59.5-60	<5	<5	<5	<10	<10

* Duplicate of 19'-20'
** Well Abandoned

ug/kg - Micrograms/kilogram
mg/kg - Milligrams/kilogram
ft bgs - feet below ground surface

b:todd

Client AFCEE-Hill AFB
Proj. No. 5301.551
By [illegible] Date 7-26
Chkd. [illegible] Date 7-26
Revision

GEOTECHNICAL RESULTS

Well Number	Sample Interval (ft bgs)	Moisture %	USC Classification	Atterburg Limits	Permeability (cm/s)
MW-1	25.5-26	23.9	CL	Liquid Limit=28 Plastic Index=7	1.29×10^{-7}
SB-3	15.5-16	NA	NA	NA	2.31×10^{-7}
MW-5	31-31.5	29.1	CL	Liquid Limit=32 Plastic Index=10	1.78×10^{-7}
MW-6	30.5-31	23.9	ML	Non-plastic	2.03×10^{-6}

NA - Not analyzed

b:TODD1

Client AFCEE - Hill AFB
Proj. No. 530.551
By Scott Givens Date 7-26
Chkd. Robert W Date 7-26
Revision

Table 1. Quantitation Report for SR# SF-0-35.

Concentration = ppb

Compound	EPA 82-I	TRIP BLANK	QC1123C 500 ppb
Benzene	2740	---	503
Toluene	372	---	508
Ethylbenzene	486	---	510
p-Xylene	784	---	510
m-Xylene	1370	---	508
o-Xylene	1140	---	510
1,3,5-Trimethylbenzene	162	---	500
1,2,4-Trimethylbenzene	495	---	507
1,2,3-Trimethylbenzene	240	---	513

QC = Quality Control Standard   --- = Below Quantitation Limit (0.5 ppb)

H will be 'background' [illegible] since there are no other BTEX analyses..

TABLE 2

GROUND WATER SAMPLING ANALYSES

Location	Concentration, ppm (mg/l)				
	Benzene	Toluene	E-Benzene	~~Comb~~ Total. Xyl.	PCE *
TP-01	0.741	2.273		1.027	0.425
TP-02	5.203	7.578	0.740	4.177	3.809
TP-03	2.701	3.112	0.322	1.655	2.447
TP-04					
TP-05					
TP-06					
TP-07	26.092	21.919	0.753	3.906	2.204
TP-08					
TP-09	0.992	2.128	0.173	0.301	1.269
TP-10	1.928	3.214		3.830	3.618
TP-11					
TP-12	1.163	0.565	0.062	0.265	0.636
TP-13		0.069		0.062	
TP-14	1.440	0.392	0.338	1.378	
TP-15					
TP-16					
TP-17			0.014	0.057	
TP-18					
TP-19	0.646		0.036	0.149	0.125
TP-20	0.124	2.699		0.504	0.303

[empty box] = < 0.005 * Tetrachloroethylene

TABLE 2 (CONTINUED)

GROUND WATER SAMPLING ANALYSES

Location	Concentration, ppm (mg/l)				
	Benzene	Toluene	E-Benzene	Comb. Xyl.	PCE *
TP-21				0.057	
TP-22	0.056	0.090	0.022	0.104	
TP-23					
TP-24					
TP-25					
TP-26					
TP-27					
TP-28					
TP-29					
TP-30					
TP-31					
TP-32					
TP-33					
TP-34					
TP-35	N/A	N/A	N/A	N/A	N/A
TP-36				0.052	
TP-37	0.789	0.930		4.179	2.525
TP-38					
TP-39					
TWP-01	0.520	1.271	0.085	0.173	0.795

[ ] = < 0.005 * Tetrachloroethylene

TABLE 2 (CONTINUED)

GROUND WATER SAMPLING ANALYSES

Location	Concentration, ppm (mg/l)				
	Benzene	Toluene	E-Benzene	Comb. Xyl.	PCE *
SGS-01	0.161	12.645	0.046	0.295	
GWS-01	0.195	0.946	0.072	0.089	
GWS-02					
MW-03	12.179	6.728		7.669	2.722
MW-07					

[ ] = < 0.005 * Tetrachloroethylene

TABLE 5

GROUNDWATER ANALYTICAL RESULTS

Analyte	MW870A-01	MW-570 (Duplicate)	CPT-42	CPT-43
BTEX (µg/L)				
Benzene	305	222	<1.0	<1.0
Toluene	690	660	<1.0	<1.0
Ethylbenzene	132	102	<1.0	<1.0
Xylenes	2,303	2,396	<1.0	<1.0
TPH (mg/L)	11.9	7.5	<1.0	<1.0

µg/L Micrograms/liter
mg/L Milligrams/liter
-- Not analyzed

Water samples were analyzed according to EPA SW-846 Methods 8020/602 and 8015 Modified.

TABLE 5

GROUNDWATER ANALYTICAL RESULTS

Analyte Volatiles - Priority Pollutants	CPT-7 (µg/L)	MW-5 (µg/L)	MW-27 Blind Dup of MW-5 (µg/L)	MW-10 µg/L)	MW-11 (µg/L)	MW-12 (µg/L)	Trip Blank 10/1/92 (µg/L)	CPT-10 (µg/L)	CPT-14 (µg/L)
Chloromethane	*71	4J	<100	<10	<10	<10	<10	<10	<500,000
Vinyl Chloride	<500	<100	<100	<10	<10	<10	<10	<10	<500,000
Bromomethane	<500	<100	<100	<10	<10	<10	<10	<10	<500,000
Chloroethane	<500	<100	<100	<10	<10	<10	<10	<10	<500,000
Trichlorofluoromethane	<250	<50	<50	<5	<5	<5	<5	<5	<250,000
Acrolein	<5,000	<1,000	<1,000	<100	<100	<100	<100	<100	<1,000,000
1,1-Dichloroethene	<250	<50	<50	<5	<5	<5	<5	<5	<250,000
Methylene Chloride	<250	<50	<50	<5	<5	11	<5	12	<250,000
Acrylonitrile	<5,000	<1,000	<1,000	<100	<100	<100	<100	<100	<1,000,000
1,1-Dichloroethane	<250	<50	<50	<5	<5	<5	<5	<5	<250,000
1,2-Dichloroethene (total)	<250	<50	<50	<5	<5	<5	<5	<5	<250,000
Chloroform	<250	<50	<50	<5	<5	<5	<5	<5	<250,000
1,1,1-Trichloroethane	<250	<50	<50	<5	<5	<5	<5	<5	<250,000
Carbon Tetrachloride	<250	<50	<50	<5	<5	<5	<5	<5	<250,000
Benzene	680	74	76	<5	26	10	<5	<5	<250,000
1,2-Dichloroethane	<250	<50	<50	<5	<5	<5	<5	<5	<250,000
Trichloroethene	<250	<50	8	<5	<5	<5	<5	<5	<250,000
1,2-Dichloropropane	<250	<50	<50	<5	<5	<5	<5	<5	<250,000
Bromodichloromethane	<250	<50	<50	<5	<5	<5	<5	<5	<250,000
2-Chloroethylvinyl ether	<500	<100	<100	<10	<10	<10	<10	<10	<500,000
cis-1,3-Dichloropropene	<250	<50	<50	<5	<5	<5	<5	<5	<250,000
Toluene	*34J	<50	<50	17	33	<5	<5	11	<250,000
trans-1,3-Dichloropropene	<250	<50	<50	<5	<5	<5	<5	<5	<250,000

TABLE 5

GROUNDWATER ANALYTICAL RESULTS
(CONTINUED)

Analyte Volatiles - Priority Pollutants	CPT-7 (μg/L)	MW-5 (μg/L)	MW-27 Blind Dup of MW-5 (μg/L)	MW-10 μg/L)	MW-11 (μg/L)	MW-12 (μg/L)	Trip Blank 10/1/92 (μg/L)	CPT-10 (μg/L)	CPT-14 (μg/L)
1,1,2-Trichloroethane	<250	<50	<50	<5	<5	<5	<5	<5	<250,000
Tetrachloroethene	*<50J	2J	3J	<5	<5	<5	<5	<5	<250,000
Dibromochloromethane	<250	<50	<50	<5	<5	<5	<5	<5	<250,000
Chlorobenzene	<250	<50	<50	<5	<5	<5	<5	<5	<250,000
Ethylbenzene	1,400	160	150	<5	21	29	<5	16	1,400,000
Xylenes (Total)	5,700	900	890	110	180	300	<5	160	13,000,000
Bromoform	<250	<50	<50	<5	<5	<5	<5	<5	<250,000
1,1,2,2-Tetrachloroethane	*<50J	<50	2J	<5	<5	<5	<5	<5	<250,000

μg/L Micrograms/liter
J Estimated value
* In an attempt to lower detection limits, a 1 ml aliquot was analyzed outside the holding time.

Water samples were analyzed according to EPA SW-846 Method 8240.

TABLE 5

GROUNDWATER ANALYTICAL RESULTS

Analyte Volatiles - Organic Compounds	870-WS-1/32' (µg/L)	870-WS-1/42' (µg/L)	870-WS-1/92' (µg/L)	870-WS-2/49' µg/L)	MW-40 Blind Dup of 870-WS-2/49' (µg/L)	870-WS-2/59' (µg/L)	870-WS-2/69' (µg/L)	CPT-40 (µg/L)	Trip Blank 11/23/93 (µg/L)
Chloromethane	<2.0	<20.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Vinyl Chloride	<2.0	<20.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Bromomethane	<2.0	<20.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Chloroethane	<2.0	<20.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Fluorotrichloromethane	<2.0	<20.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
1,1-Dichloroethene	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dichloromethane	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	10.7
trans-1,2-Dichloroethene	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chloroform	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Carbon Tetrachloride	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
* Benzene	17.4	30.5	27.0	8.4	6.5	24.0	43.5	<1.0	<1.0
1,2-Dichloroethane	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Trichloroethene (TCE)	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloropropane	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Bromodichloromethane	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
cis-1,3-Dichloropropene	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
trans-1,3-Dichloropropene	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
* Toluene	1.8	113	59.3	13.8	7.8	68.0	71.7	<1.0	<1.0
Tetrachloroethene (PCE)	<1.0	<10.0	<1.0	<1.0	<1	<1.0	<1.0	<1.0	<1.0
Chlorodibromomethane	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
* Ethylbenzene	<1.0	56.4	21.6	4.5	1.7	50.7	38.2	<1.0	<1.0
Bromoform	<2.0	<20.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
m,p-Xylene	4.9	369	107	30.2	12.2	294	258	<1.0	<1.0
o-Xylene/Styrene*	1.3	103	36.4	9.4	3.4	93.7	63.6	<1.0	<1.0

TABLE 5

GROUNDWATER ANALYTICAL RESULTS
(CONTINUED)

Analyte Volatiles - Organic Compounds	870-WS-1/32' (µg/L)	870-WS-1/42' (µg/L)	870-WS-1/92' (µg/L)	870-WS-2/49' µg/L)	MW-40 Blind Dup of 870-WS-2/49' (µg/L)	870-WS-2/59' (µg/L)	870-WS-2/69' (µg/L)	CPT-40 (µg/L)	Trip Blank 11/23/93 (µg/L)
1,1,2,2-Tetrachloroethane	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,2-Trichloroethane	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	<1.0	<10.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

µg/L Micrograms/liter

Water samples were analyzed according to EPA Method 601/602.

TABLE 5

GROUNDWATER ANALYTICAL RESULTS

Analyte Volatiles - Organic Compounds	CPT-7 (µg/L)	SGS-1 (µg/L)
1,1,2-Trichloroethane (1,1,2-T)	<500	<5
1,1-Dichloroethylene (1,1DCE)	<500	<5
1,1-Dichloroethane	<500	<5
1,2-Dichlorobenzene	<500	<5
1,2-Dichloroethane	<500	<5
1,2-Dichloropropane	<500	<5
1,3-Dichlorobenzene	<500	<5
1,4-Dichlorobenzene (p-DCB)	<500	<5
2-Butanone (MEK)	<10,000	<100
2-Chloroethylvinylether	<1,000	<10
2-Hexanone	<10,000	<100
4-Methyl-2-Pentanone (MIBK)	<1,000	<10
Acetone	<1,000	<100
Acrolein	<1,000	<10
Acrylonitrile	<500	<10
Benzene	<500	7.7
cis-1,2-Dichloroethene	<500	<5
Chlorobenzene	<500	<5
cis-1,3-Dichloropropene	<500	<5
Bromoform	<500	<5
Chloroform (Trichloromethane)	<500	<5
Chloroethane	<1,000	<10
Carbon Disulfide	<500	<5
Carbon Tetrachloride	<500	<5
Dibromochloromethane	<500	<5
Dichlorobromomethane	<500	<5
Ethyl benzene	1,800	5.5
Methyl Bromide	<1,000	<10
Methyl Chloride	<1,000	<10
Methylene Chloride	<3,000	<30

TABLE 5

GROUNDWATER ANALYTICAL RESULTS
(CONTINUED)

Analyte Volatiles - Organic Compounds	CPT-7 (μg/L)	SGS-1 (μg/L)
m,p-Xylenes	4,600	8.8
o-Xylene	1,900	19
1,1,2,2-Tetrachloroethane	<500	<5
Tetrachloroethylene (PCE)	<500	18
Styrene	<500	<5
trans-1,2-Dichloroethene	<500	<5
1,1,1-Trichloroethane	<500	<5
Trichloroethylene (TCE)	<500	<5
Trichlorofluoromethane	<1,000	<10
trans-1,3-Dichloropropene	<500	<5
Tetrahydrofuran	<10,000	<100
Toluene	<500	<5
Vinyl Chloride (VC)	<1,000	<10
Vinyl Acetate	<10,000	<100

μg/L Micrograms/liter

All samples were analyzed according to EPA SW-846 Method 8240.

TABLE 5

GROUNDWATER ANALYTICAL RESULTS

Analyte Volatile Organic Compounds (TCL)	MW-6 (µg/L)	MW-7 (µg/L)	MW-27 Blind Dup of MW-7 (µg/L)
Chloromethane	<50	<10	<10
Vinyl Chloride	<50	<10	<10
Bromomethane	<50	<10	<10
Chloroethane	<50	<10	<10
1,1-Dichloroethene	<25	<5	<5
Acetone	<100	<20	<20
Carbon Disulfide	<25	<5	<5
Methylene Chloride	<25	<5	<5
1,1-Dichloroethane	<25	<5	<5
Vinyl Acetate	<25	<5	<5
2-Butanone	<100	<20	<20
1,2-Dichloroethene (total)	<25	<5	<5
Chloroform	<25	<5	<5
1,1,1-Trichloroethane	<25	<5	<5
Carbon Tetrachloride	<25	<5	<5
Benzene	<25	<5	<5
1,2-Dichloroethane	<25	<5	<5
Trichloroethene	<25	<5	<5
1,2-Dichloropropane	<25	<5	<5
Bromodichloromethane	<25	<5	<5
cis-1,3-Dichloropropene	<25	<5	<5
4-Methyl-2-Pentanone	<25	<10	<10
Toluene	<25	<5	<5
trans-1,3-Dichloropropene	<25	<5	<5
1,1,2-Trichloroethane	<25	<5	<5
Tetrachloroethene	<25	<5	<5
2-Hexanone	<50	<10	<10
Dibromochloromethane	<25	<5	<5
Chlorobenzene	<25	<5	<5
Ethybenzene	<25	<5	<5
Xylenes (total)	<25	<5	<5
Styrene	<25	<5	<5
Bromoform	<25	<5	<5
1,1,2,2-Tetrachloroethane	<25	<5	<5

µg/L Micrograms/liter

Water samples were analyzed according to EPA CLP.

TABLE 5

GROUNDWATER ANALYTICAL RESULTS

Analyte Semi-Volatiles (TCL)	MW-6 (µg/L)	MW-7 (µg/L)	MW-27 Blind Dup of MW-7 (µg/L)
N-Nitrosodimethylamine	<20	<20	<20
Phenol	<20	<20	<20
Bis (2-chloroethyl) ether	<20	<20	<20
2-Chlorophenol	<20	<20	<20
1,3-Dichlorobenzene	<20	<20	<20
1,4-Dichlorobenzene	<20	<20	<20
Benzyl Alcohol	<40	<40	<40
1,2-Dichlorobenzene	<20	<20	<20
2-Methylphenol	<20	<20	<20
Bis (2-chloroisopropyl) ether	<20	<20	<20
4-Methylphenol	<20	<20	<20
3- or 4-Methylphenol	<20	<20	<20
Hexachloroethane	<20	<20	<20
n-Nitrosodi-n-propylamine	<20	<20	<20
Nitrobenzene	<20	<20	<20
Isophorone	<20	<20	<20
2,4-Dimethylphenol	<20	<20	<20
2-Nitrophenol	<20	<20	<20
Benzoic Acid	<100	<100	<100
Bis (2-chloroethoxy) methane	<20	<20	<20
2,4-Dichlorophenol	<20	<20	<20
1,2,4-Trichlorobenzene	<20	<20	<20
Naphthalene	<20	<20	<20
4-Chloroaniline	<40	<40	<40
Hexachlorobutadiene	<20	<20	<20
4-Chloro-3-Methylphenol	<20	<20	<20
2-Methylnaphthalene	<20	<20	<20
Hexachlorocyclopentadiene	<20	<20	<20
2,4,6-Trichlorophenol	<20	<20	<20
2,4,5-Trichlorophenol	<20	<20	<20
2-Chloronaphthalene	<20	<20	<20
2-Nitroaniline	<100	<100	<100
2,6-Dinitrotoluene	<20	<20	<20
Acenaphthylene	<20	<20	<20
3-Nitroaniline	<100	<100	<100
2,4-Dinitrophenol	<100	<100	<100
Acenaphthene	<20	<20	<20
4-Nitrophenol	<100	<100	<100
2,4-Dinitrotoluene	<20	<20	<20
Dibenzofuran	<20	<20	<20
Diethylphthalate	<20	<20	<20
4-Chlorophenyl phenyl ether	<20	<20	<20
Fluorene	<20	<20	<20

TABLE 5

GROUNDWATER ANALYTICAL RESULTS
(CONTINUED)

Analyte Semi-Volatiles (TCL)	MW-6 (µg/L)	MW-7 (µg/L)	MW-27 blind dup. of MW-7 (µg/L)
4-Nitroaniline	<40	<40	<40
4,6-Dinitro-2-methylphenol	<100	<100	<100
n-Nitrosodiphenylamine	<20	<20	<20
4-Bromophenyl phenyl ether	<20	<20	<20
Hexachlorobenzene	<20	<20	<20
Pentachlorophenol	<100	<100	<100
Phenanthrene	<20	<20	<20
Anthracene	<20	<20	<20
Carbazole	<20	<20	<20
Di-n-butylphthalate	<20	<20	<20
Fluoranthene	<20	<20	<20
Pyrene	<20	<20	<20
Butylbenzylphthalate	<20	<20	<20
Bis (2-ethylhexyl) phthalate	<20	<20	<20
3,3'-Dichlorobenzidine	<40	<40	<40
Benzo (a) anthracene	<20	<20	<20
Chrysene	<20	<20	<20
Di-n-octyl phthalate	<20	<20	<20
Benzo (b) fluoranthene	<20	<20	<20
Benzo (k) fluoranthene	<20	<20	<20
Benzo (a) pyrene	<20	<20	<20
Indeno (1,2,3-c,d) pyrene	<20	<20	<20
Dibenz (a,h) anthracene	<20	<20	<20
Benzo (g,h,i) perylene	<20	<20	<20

µg/L Micrograms/liter

Water samples were analyzed according to EPA CLP.

TABLE 5

GROUNDWATER ANALYTICAL RESULTS

Analyte Pesticides and PCBs (TCL)	MW-6 (µg/L)	MW-7 (µg/L)	MW-27 Blind Dup of MW-7 (µg/L)
Alpha BHC	<0.10	<0.10	<0.10
Beta BHC	<0.10	<0.10	<0.10
Delta BHC	<0.10	<0.10	<0.10
Gamma BHC - Lindane	<0.10	<0.10	<0.10
Heptachlor	<0.10	<0.10	<0.10
Aldrin	<0.10	<0.10	<0.10
Heptachlor Epoxide	<0.10	<0.10	<0.10
Endosulfan I	<0.10	<0.10	<0.10
Dieldrin	<0.10	<0.10	<0.10
p,p'-DDE	<0.10	<0.10	<0.10
Endrin	<0.10	<0.10	<0.10
Endosulfan II	<0.10	<0.10	<0.10
p,p'-DDD	<0.10	<0.10	<0.10
Endosulfan Sulfate	<0.10	<0.10	<0.10
p,p'-DDT	<0.10	<0.10	<0.10
Endrin ketone	<0.10	<0.10	<0.10
alpha-Chlordane	<0.10	<0.10	<0.10
gamma-Chlordane	<0.10	<0.10	<0.10
Methoxychlor	<0.50	<0.50	<0.50
Toxaphene	<1.0	<1.0	<1.0
Aroclor-1016	<1.0	<1.0	<1.0
Aroclor-1221	<1.0	<1.0	<1.0
Aroclor-1232	<1.0	<1.0	<1.0
Aroclor-1242	<1.0	<1.0	<1.0
Aroclor-1248	<1.0	<1.0	<1.0
Aroclor-1254	<1.0	<1.0	<1.0
Aroclor-1260	<1.0	<1.0	<1.0

µg/L Micrograms/liter

Water samples were analyzed according to EPA SW-846 Method 8081

TABLE 5

GROUNDWATER ANALYTICAL RESULTS

nalyte - Metals (TCL)	MW-6 (mg/L)	MW-7 (mg/L)	MW-27 Blind Dup of MW-7 (mg/L)
ıminum	1.43	33.6	26.1
timony	<0.25	<0.25	<0.25
senic	<0.010	<0.010	<0.010
rium	0.71	0.20	0.19
ryllium	<0.005	<0.005	<0.005
dmium	<0.005	<0.005	<0.005
lcium	4.2	267	225
romium	<0.05	0.13	0.07
›alt	<0.05	0.05	0.05
›per	0.02	0.07	0.05
[illegible]	1.43	75.4	67.8
ıd	<0.05	<0.04	<0.04
gnesium	84	55	45
nganese	1.62	1.36	1.13
rcury	<0.0005	<0.005	<0.005
:kel	<0.04	0.05	0.05
assium	3.95	0.509	0.513
enium	0.008	<0.005	<0.005
ver	<0.01	<0.01	<0.01
lium	703	456	455
ıllium	<0.1	<0.002	<0.002
ıadium	0.07	0.25	0.15
c	0.06	0.29	0.23
ınide	<0.005	<0.005	<0.005

'L Milligrams/liter

v· ·er samples were analyzed according to EPA CLP.

TABLE 3

SOIL ANALYTICAL RESULTS

Analyte	MW-1 (16'-17')	MW-1 (18'-19')	SB870A-02 (15'-16')	SB870A-02 (17'-18')	SB870A-03 (11'-12')	SB870A-03 (19'-20')	SB870A-03 (29'-30') (Duplicate of 19'-20')	Trip Blank (Water) 11/7/92 (µg/L)
	Soil Boring and Sample Depth							
BTEX (µg/kg)								
Benzene	150	564	43.2	13.0	9,400	338	22,200	<1.0
Toluene	129	145	51.3	60.2	115,000	595	187,000	<1.0
Ethylbenzene	57.0	341	52.2	57.7	66,700	138	83,100	<1.0
Xylenes	318	2,249	457.3	509	634,000	1,143	744,000	<1.0
TPH (mg/kg)	<10.0	98.3	23.2	37.0	2,790	<10.0	15,100	<1.0
Total Organic Carbon (mg/kg)	--	--	--	--	--	1,100	--	--
Moisture (%)	21.9	19.4	18.9	24.2	7.3	20.3	14.0	--

µg/kg Micrograms/kilogram
mg/kg Milligrams/kilogram
µg/L Micrograms/liter
-- Not analyzed

Soil Samples were analyzed according to EPA SW-846 Methods 8020 and 8015 Modified.

Well #
MW-1
MW-2

BTEX

TABLE 3

SOIL ANALYTICAL RESULTS
(CONTINUED)

Analyte	Soil Boring and Sample Depth								
	MW-5 (15.5'-16')	MW-6 (21'-21.5')	Trip Blank (Water) 6/17/92 (µg/L)	MW-8 (11'-11.5')	Trip Blank (Water) 6/18/92 (µg/L)	MW-9 (17'-17.5')	MW-1A (17'-17.5') Abandoned	Trip Blank (Water) 6/29/92	MW-1A (59.5'-60') Abandoned
BTEX&N (µg/g)									
Benzene	2.0	0.009	<1.0	<0.005	<1.0	0.10	10	<1.0	<0.009
Toluene	0.11	<0.005	<1.0	0.031	1.4	0.10	23	<1.0	<0.005
Ethylbenzene	0.26	<0.005	<1.0	0.12	<1.0	0.18	16	<1.0	<0.005
Xylenes	2.8	<0.005	3.5	0.92	5.5	5.4	74	2.9	<0.01
Naphthelene	1.4	0.05	<5.0	4.4	<5.0	2.9	6.6	<5	<0.01
TPH (mg/g)	0.02	<0.01	--	0.11	--	0.36	1.5	--	<0.01

µg/g Micrograms/gram
mg/g Milligrams/gram
µg/L Micrograms/liter
-- Not analyzed

Soil Samples were analyzed according to EPA SW-846 Methods 8020 and 8015 Modified.

mg/kg ?

TABLE 4

GEOTECHNICAL RESULTS

Geotechnical Characteristic	Sample ID and Sample Depth MW-1 (25.5'-26')	SB-3 (15.5'-16')	MW-5 (31'-31.5')	MW-6 (30.5'-31')
Moisture (%)	23.9	NA	29.1	23.9
USC Classification	CL	NA	CL	ML
Atterburg Limits	Liquid Limit=28 Plastic Index=7	NA	Liquid Limit=32 Plastic Index=10	Non-plastic
Permeability (cm/s)	1.29×10^{-7}	2.31×10^{-7}	1.78 x 10-7	2.03×10^{-6}

NA Not analyzed

New Table

Field Data Hill Air Force base, Utah								
Sample	Date	pH	Cond	Temp °C	Redox	Total Alk	cl mg/1	Ferrous Iron
71-29CPT-Geo Depth 1	8-2-93	7.1	1604	25	99	457	220	<.05
71-19CPT-Geo Depth 1	8-2-93	7.1	1196	25	-63	612	17	.6
71-29CPT-Geo Depth 2	8-2-93	7.4	1256	22.5	-137	452	108	<.05
71-38CPT-Geo Depth 2	8-3-93	7.3	1628	18	56	646	168	<.05
71-17CPT-Geo Depth 1	8-3-93	7.3	1127	24	135	384	78	<.05
71-17CPT-Geo Depth 2	8-3-93	7.3	1495	22	-10	451	192	.2
71-31CPT-Geo Depth 1	8-3-93	7.3	1099	25	162	394	94	.1
71-31CPT-Geo Depth 2	8-3-93	7.3	1082	23	152	378	75	<.05
71-18CPT-Geo Depth 1	8-3-93	Not enough sample for field data					-	.2
71-18CPT-Geo Depth 2	8-3-93	7.4	1151	20	180	440	84	<.05
71-23CPT-Geo Depth 1	8-5-93	7.4	1451	19	274	632	86	.1
71-39CPT-Geo Depth 1	8-5-93	7.7	1525	21	179	592	174	.05
71-39CPT-Geo Depth 2	8-5-93	8.3	1321	24	207	451	100	<.05

91.

Field Data
Hill Airforce Bs. Ut.

Sample	Date	pH	Cond	Temp °C	Redox	Total Alk	Cl mg/l	Ferrous iron
71-29 CPT-Geo Depth 1	8-2-93	7.1	1604	25	99	457	220	<.05
71-19 CPT-Geo Depth 1	8-2-93	7.1	1196	25	-63	612	17	.6
71-29 CPT-Geo Depth 2	8-2-93	7.4	1256	22.5	-137	452	108	<.05
71-38 CPT-Geo-Depth 1	8-3-93	7.3	1628	18	56	646	168	<.05
71-17 CPT-Geo Depth 1	8-3-93	7.3	1127	24	135	384	78	<.05
71-17 CPT-Geo Depth 2	8-3-93	7.3	1495	22	-10	451	192	.2
71-31 CPT-Geo Depth 1	8-3-93	7.3	1099	25	162	394	94	.1
71-31 CPT-Geo Depth 2	8-3-93	7.3	1082	23	152	378	75	<.05
71-18 CPT-Geo-Depth 1	8-3-93	- Not enough sample for field Data					—	.2
71-18 CPT-Geo-Depth 2	8-3-93	7.4	1151	20	180	440	84	<.05
71-23 CPT-Geo Depth 1	8-5-93	7.4	1451	19	274	632	86	.1
71-39 CPT-Geo Depth 1	8-5-93	7.7	1525	21	179	592	174	.05
71-39 CPT-Geo Depth 2	8-5-93	8.3	1321	24	207	451	100	<.05

Don Kidd? ar PJ

92,

Field Data Hill Air Forcr Base, Utah, Phase 2

Sample	Date	pH	ConD	Well Temp °C	Redox	Total Alk	cl mg/1	Ferrous Iron	Water Level Ft'
82 MW-11	8/18/93	7.0	1209	14.8	66	543	41	.2	25.52
82 MW-10	8/18/93	7.1	1162	15.4	125	518	43	<.05	28.60
82 A	8/19/93	7.2	1677	16.5	170	576	163	<.05	5.10
82 C	8/20/93	6.9	1828	15.5	-125	745	160	2.1	22.08
82 B	8/20/93	6.9	1421	16.9	213	450	158	<.05	24.98
82 F	8/21/93	7.5	1275	22.6	243	550	60	<.05	6.20
82 D	8/21/93	7.3	2520	15.9	40	959	190	.4	23.76
82 E	8/22/93	7.3	1042	22.8	192	349	80	<.05	4.88
82 H	8/22/93	7.1	1400	18.0	190	485	141	<.05	11.16

only new field, the rest [illegible] the table

Field Data Hill Air Forcr Base, Utah, Phase 2										
Sample	Date	pH	ConD	Well Temp °C	Redox mill-volts	Total Alka-linity mg/l	Cl mg/l	Ferrous Iron mg/l	D.O. mg/l	Depth to Water Level Ft'
MW-11	8/18/93	7.0	1209	14.8	66	543	41	.2	0.1	25.52
MW-10	8/18/93	7.1	1162	15.4	125	518	43	<.05	0.6	28.60
82 A	8/19/93	7.2	1677	16.5	170	576	163	<.05	0.4	5.10
82 C	8/20/93	6.9	1828	15.5	-125	745	160	2.1	0.5	22.08
82 B	8/20/93	6.9	1421	16.9	213	450	158	<.05	1.0	24.98
82 F	8/21/93	7.5	1275	22.6	243	550	60	<.05	1.1	6.20
82 D	8/21/93	7.3	2520	15.9	40	959	190	.4	1.3	23.76
82 E	8/22/93	7.3	1042	22.8	192	349	80	<.05	5.6	4.88
82 H	8/22/93	7.1	1400	18.0	190	485	141	<.05	6.3	11.16

Hill AFB Monitoring Well Samples

Location	Date	pH	D.O. mg/l	Temp. C°	Depth To Water feet	Fe^{+2} mg/l
82A	11/8/93	7.4	0.3	14.8	4.46	0.17
82B	11/8/93	7.5	1.2	12.9	25.37	0.11
82C	11/9/93	6.3	0.4	14.2	22.17	0.84
82D	11/9/93	7.2	0.8	14.1	23.72	1.7
82E	11/8/93	7.4	2.7	16.5	6.26	0.02
82F	11/8/93	7.6	1.1	16.8	7.30	0.04
82H	11/8/93	7.4	5.4	15.7	11.46	0.19
MW-10	11/9/93	7.4	1.5	15.0	28.05	0.22
MW-11	11/9/93	7.4	0.1	14.7	25.74	0.05

Don Kampbell

SAMPLE NAME	BENZENE	TOLUENE	ETHYLBENZENE	p-XYLENE	m-XYLENE	o-XYLENE	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB	FUEL CARBON
100 PPB	1.02E+02	1.01E+02	9.95E+01	9.78E+01	9.78E+01	9.69E+01	9.49E+01	9.49E+01	9.57E+01	N/A
QC, OBSERVED, PPB	5.17E+01	5.30E+01	5.18E+01	4.79E+01	4.84E+01	4.98E+01	4.57E+01	4.82E+01	4.67E+01	N/A
QC, TRUE VALUE, PPB	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	N/A
GC LAB BLANK, PPB	ND	ND	ND	ND	ND	ND	ND	ND	ND	N/A
G-2 SEWER Storm	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
G-3 STORM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
82 A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
82 B	ND	4.29E+00	ND	ND	ND	ND	1.06E+00	1.43E+00	ND	8.13E+00
82 C	4.92E+00	3.13E+00	2.65E+01	4.28E+01	4.72E+01	2.62E+00	2.38E+02	3.24E+02	1.20E+02	2.10E+03
82 D	9.58E+01	1.04E+01	1.47E+02	1.49E+02	3.83E+02	1.03E+02	1.29E+02	1.83E+02	8.88E+01	2.47E+03
82 E	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
82 F	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
500 PPB	4.73E+02	4.76E+02	4.79E+02	4.75E+02	4.79E+02	4.75E+02	4.79E+02	4.71E+02	4.68E+02	ND
82-H	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
82-MW-11	3.36E+02	9.03E+01	1.39E+02	2.30E+02	6.35E+02	2.04E+02	7.18E+01	1.65E+02	6.93E+01	2.08E+03
82-MW-10 - is this MW-10?	ND	2.90E+02	4.43E+02	4.01E+02	2.47E+03	1.28E+03	5.75E+02	8.28E+02	6.07E+02	1.80E+04
GC LAB BLANK, PPB	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2.5 PPB	2.30E+00	2.09E+00	3.12E+00	2.69E+00	1.93E+00	2.43E+00	2.47E+00	2.25E+00	2.39E+00	N/A
QC, OBSERVED, PPB	5.24E+01	5.29E+01	5.27E+01	4.88E+01	4.89E+01	5.09E+01	4.74E+01	4.95E+01	4.82E+01	N/A
QC, TRUE VALUE, PPB	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	N/A

- BLG 3 - No2

Alnt in table

None Detected; * Lower Limit of Quantitation = 10 ppb

Pt. 17-Nov-93 SR: SF-0-27

OI-P&T/GC - PID Analyses for Dr. Kampbell

Units = ng/ml Analyst: L S

* µg/L

SAMPLE NAME	BENZENE	TOLUENE	ETHYLBENZENE	p-XYLENE	m-XYLENE	o-XYLENE	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB	FUEL CARB
100 PPB	1.01E+02	1.01E+02	1.01E+02	1.01E+02	1.01E+02	1.00E+02	1.01E+02	1.01E+02	1.00E+02	N/A
QC, OBSERVED, PPB	4.83E+01	4.93E+01	4.95E+01	5.01E+01	4.94E+01	4.99E+01	4.77E+01	5.14E+01	4.90E+01	N/A
QC, TRUE VALUE, PPB	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	N/A
82-A	ND	BLQ	ND	ND	ND	ND	1.14E+00	9.65E-01	BLQ	BLQ
82-B	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
82-B Duplicate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
82-C	ND	8.38E+00	6.81E+00	2.02E+01	6.38E+00	1.82E+00	7.97E+01	6.89E+01	6.41E+01	1.13E+
82-D	1.74E+02	4.64E+00	3.08E+01	1.41E+02	2.93E+02	5.75E+01	8.94E+01	1.19E+02	7.71E+01	1.50E+
82-E	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
82-F	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
82-H	ND	ND	ND	ND	ND	ND	9.42E-01	BLQ	BLQ	BLQ
MW-10	7.44E+00	8.29E+01	1.90E+02	1.89E+02	1.09E+03	5.05E+02	1.74E+02	2.97E+02	2.12E+02	4.52E+
MW-11	1.05E+02	4.65E+01	3.99E+01	6.50E+01	2.21E+02	8.84E+01	3.00E+01	5.67E+01	2.87E+01	9.25E+
GC LAB BLANK, PPB	ND	ND	ND	ND	ND	ND	ND	ND	ND	N/A
500 PPB	4.71E+02	4.70E+02	4.67E+02	4.67E+02	4.68E+02	4.74E+02	4.73E+02	4.75E+02	4.81E+02	N/A
QC, OBSERVED, PPB	4.89E+01	4.96E+01	4.98E+01	5.00E+01	4.90E+01	5.02E+01	4.65E+01	5.08E+01	4.90E+01	N/A
QC, TRUE VALUE, PPB	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	N/A
10 PPB	1.00E+01	1.00E+01	1.02E+01	9.88E+00	9.61E+00	9.98E+00	9.55E+00	9.71E+00	9.85E+00	N/A

ND = None Detected; N/A = Not Analyzed; BLQ = Below Limit of Quantitation, 1 ppb

11-9-93 samples

OI-P&T/GC-FID:PID Eglin AFB Aqueous Samples For Dr. Kampbell

Units = ng/mL Analyst: Secre

SAMPLE NAME	BENZENE	TOLUENE	ETHYLBENZENE	p-XYLENE	m-XYLENE	o-XYLENE	MESITYLENE	PSEUDOCUMENE	1,2,3-TMB	FUEL CARBON
GC LAB BLANK, PPB	ND	ND	ND	ND	ND	ND	ND	ND	ND	N/A
10 PPB	9.43E+00	9.20E+00	9.49E+00	9.28E+00	9.11E+00	9.49E+00	9.05E+00	9.13E+00	9.57E+00	N/A
QC, OBSERVED, PPB	4.65E+01	4.91E+01	5.14E+01	4.82E+01	4.84E+01	5.06E+01	4.78E+01	5.07E+01	4.82E+01	N/A
QC, TRUE VALUE, PPB	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	N/A
71-14 CPT DEPTH [illegible]	5.14E+01	BLQ	4.61E+02	8.69E+02	2.73E+03	9.84E+02	2.95E+02	7.35E+02	3.30E+02	7.80E+03
71-17 CPT DEPTH 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
71-17 CPT DEPTH 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
71-18 CPT DEPTH 1	ND	1.27E+00	ND	ND	BLQ	ND	ND	1.10E+00	1.08E+00	3.46E+00
71-18 CPT DEPTH 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
71-29 CPT DEPTH 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
71-29 CPT DEPTH 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
71-31 CPT DEPTH 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
71-31 CPT DEPTH 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
71-31 CPT DEPTH 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
100 PPB	9.77E+01	9.70E+01	9.62E+01	9.53E+01	9.57E+01	9.57E+01	9.47E+01	9.39E+01	9.52E+01	2.06E+00
71-8 CPT DEPTH 1	ND	BLQ	ND	ND	ND	2.20E+00	ND	ND	ND	ND
71-23 CPT DEPTH 1	ND	BLQ	ND	ND	ND	ND	ND	ND	ND	ND
71-39 CPT DEPTH 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
71-39 CPT DEPTH 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
GC LAB BLANK, PPB	ND	ND	ND	ND	ND	ND	ND	ND	ND	N/A
QC, OBSERVED, PPB	4.74E+01	4.98E+01	5.27E+01	4.89E+01	4.91E+01	5.11E+01	4.80E+01	5.12E+01	4.94E+01	N/A
QC, TRUE VALUE, PPB	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	N/A

ND1
BLQ1

BLQ2

ND=None Detected; BLQ=Below Limit of Quantitation, 1 ppb; *BLQ=4 ppb; N/A = Not Analyzed

*Not in table

SAMPLE NAME	BENZENE	TOLUENE	ETHYLBENZENE	p-XYLENE	m-XYLENE	o-XYLENE	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB	FUEL CARBON
QC, OBSERVED, PPB	4.52E+01	4.56E+01	4.87E+01	4.45E+01	4.27E+01	4.67E+01	4.32E+01	4.62E+01	4.35E+01	N/A
QC, TRUE VALUE, PPB	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	N/A
2 PPB	1.79E+00	1.77E+00	2.13E+00	2.27E+00	1.84E+00	1.99E+00	1.99E+00	1.88E+00	1.89E+00	N/A
-482-MW-10 Duplicate	ND	3.40E+02	5.43E+02	4.71E+02	2.88E+03	1.49E+03	7.13E+02	9.74E+02	6.83E+02	1.77E+04

ND = None Detected; * Lower Limit of Quantitation = 2 ppb; N/A = Not Analyzed

MONTGOMERY WATSON

March 2, 1994

Ogden Air Logistics Center
Environmental Management Directorate
OO-ALC/EMR, Building 5
7274 Wardleigh Road
Hill Air Force Base, Utah 84056

Project No.: 2208.0682

ATTN: Mr. Andrew Gemperline
Technical Project Manager

PROJECT: December 1993/January 1994
Quarterly Ground-Water Sampling Letter
Report Contract No. F42650-92-D-0005, Delivery Order 5019

Dear Andrew:

The purpose of this letter report is to briefly summarize the recent quarterly ground-water sampling event. This work involved sampling 11 monitoring wells and collecting two blind duplicate samples; see Figure 1 for the location of wells located at Site 870 (MW-1, MW-2, MW-3, MW-4, MW-5, MW-6, MW-7, MW-8, MW-9, MW-13, and MW-14). The sampling was initially conducted over the period of December 16 to 21, 1993, however, due to unforeseen sampling and laboratory mistakes 7 of the 11 monitoring wells needed to be resampled for benzene, toluene, ethylbenzene, xylenes, and naphthalene (BTEXN). The seven wells (MW-1, MW-2, MW-3, MW-4, MW-5, MW-6, and MW-8) were then resampled over the period of January 27 and 28, 1994. Monitoring wells MW-10 and MW-11 were sampled in October 1993 as part of the Natural Attenuation Study. All ground-water sampling was conducted according to the methods outlined in the Draft Final Treatability Study Work Plan (Montgomery, 1993).

The analytical data from this and previous sampling events are summarized in Table 1, copies of all laboratory data reports are provided in Attachment A. All 11 wells sampled during the quarterly sampling were analyzed for; BTEXN, 1,2,4-Trimethylbenzene (TMB), 1,3,5-TMB, sulfate, nitrate, nitrite, iron, and dissolved methane. The samples collected for dissolved methane were analyzed by the United States Environmental Protection Agency Robert S. Kerr Environmental Research Lab.

The results of the quarterly ground-water sampling and previous sampling events for benzene are shown in Figure 2. The benzene data have been plotted because benzene is typically the fuel component that guides regulatory compliance. Over time, the figure may allow for trends to be identified related to the concentration of benzene.

4525 South Wasatch Blvd.
Suite 200
Salt Lake City, Utah
84124-4799

Tel 801 272 1900
Fax 801 272 0430

We appreciate the opportunity to work on this project for the Air Force. Please do not hesitate to call us if you have questions or comments regarding this report, or any other aspect of the work at Site 870.

Very truly yours,

MONTGOMERY WATSON

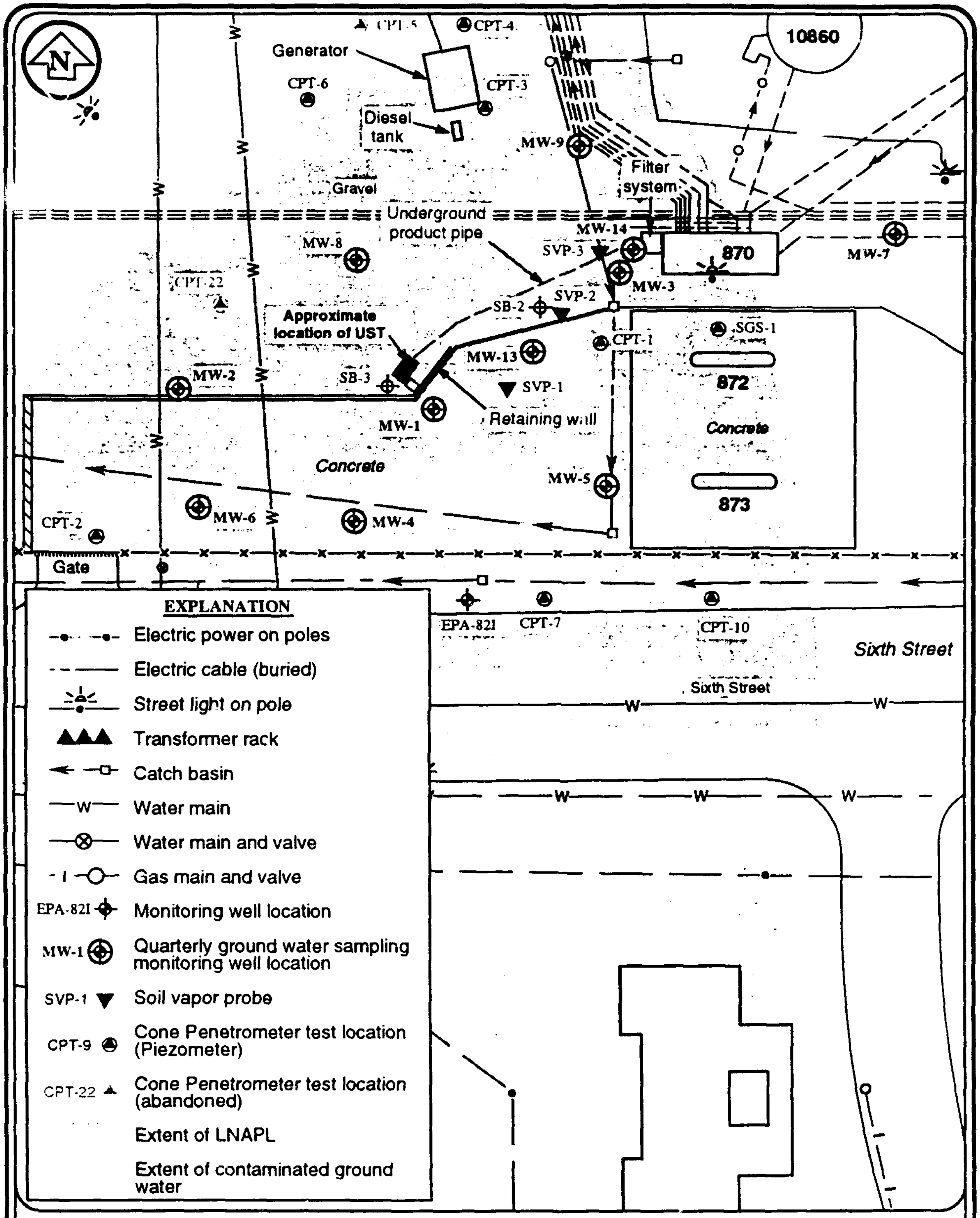
Robert Glascott
Project Geologist

David Fulton, P.G.
Project Manager

/pa

Enclosures

cc: Bill Helms, PKOE



Source: Modified from Hill AFB Civil Engineering Department records.

HILL AIR FORCE BASE
SITE 870/PATRIOT HILLS
SITE MAP
FIGURE 1

PROJECT NO. 2208.0682

TABLE 1

SITE 870/PATRIOT HILLS GROUND-WATER SAMPLING RESULTS FOR MONITORING WELLS MW-1 THROUGH MW-14

Analytes	MW-1		MW-2	MW-3		MW-4	MW-5		MW-6	
	Sampled 11/18/91	Sampled 12/93 - 1/94	Sampled 12/93 - 1/94	Sampled 10/92	Sampled 12/93 - 1/94	Sampled 12/93 - 1/94	Sampled 9/92	Sampled 12/93 - 1/94	Sampled 9/92	Sampled 12/93 - 1/94
Iron (mg/l)	NA	10.8	50.5	NA	8.2	13.6	NA	6.41	NA	10.3
Nitrate (mg/l)	NA	<0.05	0.25	NA	<0.05	1.68	NA	<0.05	NA	0.04
Nitrite (mg/l)	NA	<0.01	<0.01	NA	0.025	0.637	NA	<0.01	NA	0.031
Sulfate (mg/l)	NA	2	40	NA	<2	<2	NA	<2	NA	21
Methane (mg/l)	NA	41	<1	NA	459	12	NA	2,040	NA	2
1,2,4-Trimethylbenzene (µg/l)	NA	680	750	NA	1,000	1,500	NA	960	NA	1,500
1,3,5-Trimethylbenzene (µg/l)	NA	330	350	NA	480	550	NA	450	NA	650
Benzene (µg/l)	305	475	51	12.18	2,320	930	74	416	<25	24.5
Toluene (µg/l)	690	88	56.3	6.73	1,300	1,830	<50	250	<25	10.1
Ethylbenzene (µg/l)	132	183	73.3	<1	376	450	160	246	<25	18.6
Xylenes (µg/l)	2,283	1,160	776	7.67	5,470	5,120	900	2,508	<25	155.9
Naphthalene (µg/l)	NA	97	85	NA	<100	<100	NA	<100	NA	99.1

NA Not analyzed
mg/l Milligrams per liter
µg/l Micrograms per liter

Iron analyzed by EPA Method SW-846-6010
Nitrate/nitrite analyzed by EPA Method 353.3
Sulfate analyzed by EPA Method 375.4
1,2,4- and 1,3,5-Trimethylbenzene analyzed accoording to EPA Method 524.2
All monitoring wells were analyzed for BTEXN according to EPA Method SW846-8020
Methane was analyzed using the methods described in "Dissolved Oxygen & Methane in Water by a GC Headspace Equilibration Technique" by Kambell et. al. in International Journal of Environmental Analytical Chemistry, Volume 36, pp. 249-257.

TABLE 1

SITE 870/PATRIOT HILLS GROUND-WATER SAMPLING RESULTS FOR MONITORING WELLS MW-1 THROUGH MW-14 (CONTINUED)

Analytes	MW-7		MW-8	MW-9	MW-10			MW-11		MW-12
	Sampled 9/92	Sampled 12/93 - 1/94	Sampled 12/93 - 1/94	Sampled 12/93 - 1/94	Sampled 10/92	Sampled 10/92	Sampled 8/93	Sampled 8/93	Sampled 9/93	Sampled 10/92
Iron (mg/l)	NA	1.36	5.22	2.07	NA	NA	NA	0.2	NA	NA
Nitrate (mg/l)	NA	11.78	0.28	0.4	NA	NA	NA	NA	NA	NA
Nitrite (mg/l)	NA	0.021	<0.01	0.577	NA	NA	NA	NA	NA	NA
Sulfate (mg/l)	NA	26	11	22	NA	NA	NA	98	NA	NA
Methane (mg/l)	NA	<1	6	6	NA	NA	NA	0.117	NA	NA
1,2,4-Trimethylbenzene (µg/l)	NA	<1	280	650	NA	NA	828	165	NA	NA
1,3,5-Trimethylbenzene (µg/l)	NA	<1	140	150	NA	NA	575	71.8	NA	NA
Benzene (µg/l)	<5	<1	18.6	72	1.16	<5	<10	336	26	<5
Toluene (µg/l)	<5	<1	10.8	27	0.57	17	290	90.3	33	<5
Ethylbenzene (µg/l)	<5	<1	29.3	35	0.06	<5	443	139	21	29
Xylenes (µg/l)	<5	<1	314.4	558	0.27	110	4,151	1,069	180	300
Naphthalene (µg/l)	NA	<2	294	598	NA	NA	NA	NA	NA	NA

NA Not analyzed
mg/l Milligrams per liter
µg/l Micrograms per liter

Iron analyzed by EPA Method SW-846-6010
Nitrate/nitrite analyzed by EPA Method 353.3
Sulfate analyzed by EPA Method 375.4
1,2,4- and 1,3,5-Trimethylbenzene analyzed accoording to EPA Method 524.2
All monitoring wells were analyzed for BTEXN according to EPA Method SW846-8020
Methane was analyzed using the methods described in "Dissolved Oxygen & Methane in Water by a *GC Headspace Equilibration Technique*"
by Kambell et. al. in International Journal of Environmental Analytical Chemistry, Volume 36, pp. 249-257.

TABLE 1

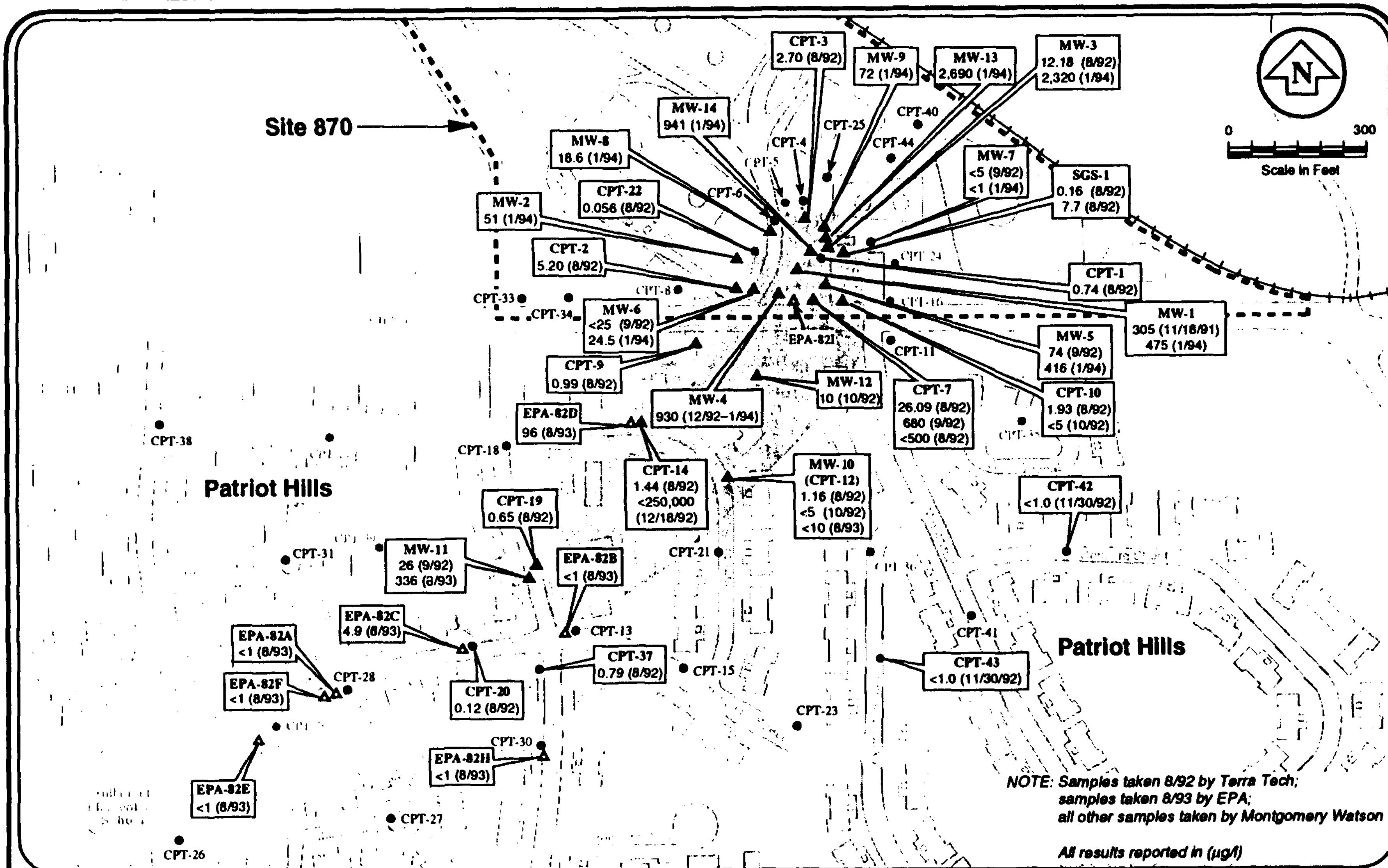
SITE 870/PATRIOT HILLS GROUND-WATER SAMPLING RESULTS FOR MONITORING WELLS MW-1 THROUGH MW-14 (CONTINUED)

Analytes	MW-13 Sampled 12/93 - 1/94	MW-14 Sampled 12/93 - 1/94
Iron (mg/l)	10.3	5.96
Nitrate (mg/l)	0.06	1.72
Nitrite (mg/l)	0.037	0.187
Sulfate (mg/l)	3	27
Methane (mg/l)	498	23
1,2,4-Trimethylbenzene (µg/l)	1,113	1,400
1,3,5-Trimethylbenzene (µg/l)	470	650
Benzene (µg/l)	2,690	941
Toluene (µg/l)	1,570	2,800
Ethylbenzene (µg/l)	589	505
Xylenes (µg/l)	4,280	5,510
Naphthalene (µg/l)	401	187

NA Not analyzed
mg/l Milligrams per liter
µg/l Micrograms per liter

Iron analyzed by EPA Method SW-846-6010
Nitrate/nitrite analyzed by EPA Method 353.3
Sulfate analyzed by EPA Method 375.4
1,2,4- and 1,3,5-Trimethylbenzene analyzed accoording to EPA Method 524.2
All monitoring wells were analyzed for BTEXN according to EPA Method SW846-8020
Methane was analyzed using the methods described in "Dissolved Oxygen & Methane in Water by a GC Headspace Equilibration Technique" by Kambell et. al. in *International Journal of Environmental Analytical Chemistry*, Volume 36, pp. 249-257.

PROJECT NO. 2208.0682



NOTE: *Samples taken 8/92 by Terra Tech; samples taken 8/93 by EPA; all other samples taken by Montgomery Watson*

All results reported in (µg/l)

CPT-28 ● Cone penetrometer test point/piezometer	EPA-82H △ EPA research well location
	● Abandoned CPT location
MW-12 ● Monitoring well location	Extent of LNAPL
CPT-19 ▲ Free phase JP-4 detected	Extent of contaminated ground water

HILL AIR FORCE BASE
SITE 870/PATRIOT HILLS
GROUND-WATER SAMPLING RESULTS (BENZENE ONLY)
FIGURE 2

ATTACHMENT A

LABORATORY ANALYTICAL DATA

Mountain States Analytical

RECEIVED

FEB 04 1994

MONTGOMERY WATSON

January 31, 1994

Mr. Robert Glascot
Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Reference:
Project: HAFB 870
Project No.: 2208.0682
MSAI Group: 3676

Dear Mr. Glascot:

Enclosed are the analytical results for your project referenced above. The following samples are included in the report.

Site 870 MW-3
Site 870 MW-1
Site 870 Trip Blk 1/27/94
Site 870 MW-20
Site 870 MW-8

All holding times were met for the tests performed on these samples.

If the report is acceptable, please approve the enclosed invoice and forward it for payment.

Thank you for selecting Mountain States Analytical, Inc. to serve as your analytical laboratory on this project. If you have any questions concerning these results, please feel free to contact me at any time.

We look forward to working with you on future projects.

With Regards,

Leon A. Peterson
Project Manager

Analytical Report

Mountain States Analytical
The Quality Solution

Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Attn: Mr. Robert Glascot
Project: HAFB 870

Sample ID: Site 870 MW-3
Matrix: Waste Water

MSAI Sample: 15462
MSAI Group: 3676
Date Reported: 01/31/94

Discard Date: 03/02/94
Date Submitted: 01/27/94
Date Sampled: 01/27/94
Collected by: RG
Purchase Order: Reanalysis
Project No.: 2208.0682

Test	Analysis	Results as Received	Units	Limit of Quantitation
4264	BTEX and Naphthalene			
	Method: 600/SW-846 602/8020			
	Benzene	2,320	ug/l	(1) 50
	Toluene	1,300	ug/l	50
	Ethylbenzene	376	ug/l	50
	m,p-Xylene	3,940	ug/l	50
	o-Xylene	1,530	ug/l	50
	Naphthalene	< 100	ug/l	100

(1) Due to high target compound level(s), dilution was required. The LOQ was raised accordingly.

Respectfully Submitted,
Reviewed and Approved by:

Leon A. Peterson
Project Manager

1645 West 2200 South, Salt Lake City, Utah 84119 (801) 973-0050 FAX (801) 972-6278

Analytical Report

Mountain States Analytical
The Quality Solution

Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Attn: Mr. Robert Glascot
Project: HAFB 870

Sample ID: Site 870 MW-20
Matrix: Waste Water

MSAI Sample: 15463
MSAI Group: 3676
Date Reported: 01/31/94

Discard Date: 03/02/94
Date Submitted: 01/27/94
Date Sampled: 01/27/94
Collected by: RG
Purchase Order: Reanalysis
Project No.: 2208.0682

Test	Analysis	Results as Received	Units	Limit of Quantitation
4264	BTEX and Naphthalene			
	Method: 600/SW-846 602/8020			
	Benzene	429	ug/l	20
	Toluene	75	ug/l	20
	Ethylbenzene	170	ug/l	20
	m,p-Xylene	793	ug/l	20
	o-Xylene	276	ug/l	20
	Naphthalene	67	ug/l	40

Respectfully Submitted,
Reviewed and Approved by:

Leon A. Peterson
Project Manager

1645 West 2200 South, Salt Lake City, Utah 84119 (801) 973-0050 FAX (801) 972-6278

Analytical Report

Mountain States Analytical
The Quality Solution

Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Attn: Mr. Robert Glascot
Project: HAFB 870

Sample ID: Site 870 MW-1
Matrix: Waste Water

MSAI Sample: 15464
MSAI Group: 3676
Date Reported: 01/31/94

Discard Date: 03/02/94
Date Submitted: 01/27/94
Date Sampled: 01/27/94
Collected by: RG
Purchase Order: Reanalysis
Project No.: 2208.0682

Test	Analysis	Results as Received	Units	Limit of Quantitation
4264	BTEX and Naphthalene			
	Method: 600/SW-846 602/8020			
	Benzene	475	ug/l	20
	Toluene	88	ug/l	20
	Ethylbenzene	183	ug/l	20
	m,p-Xylene	856	ug/l	20
	o-Xylene	304	ug/l	20
	Naphthalene	97	ug/l	40

Respectfully Submitted,
Reviewed and Approved by:

Leon A. Peterson
Project Manager

Analytical Report

Mountain States Analytical
The Quality Solution

Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Attn: Mr. Robert Glascot
Project: HAFB 870

Sample ID: Site 870 MW-8
Matrix: Waste Water

MSAI Sample: 15465
MSAI Group: 3676
Date Reported: 01/31/94

Discard Date: 03/02/94
Date Submitted: 01/27/94
Date Sampled: 01/27/94
Collected by: RG
Purchase Order: Reanalysis
Project No.: 2208.0682

Test	Analysis	Results as Received	Units	Limit of Quantitation
4264	BTEX and Naphthalene			
	Method: 600/SW-846 602/8020			
	Benzene	18.6	ug/l	5.0
	Toluene	10.8	ug/l	5.0
	Ethylbenzene	29.3	ug/l	5.0
	m,p-Xylene	281	ug/l	5.0
	o-Xylene	33.4	ug/l	5.0
	Naphthalene	294	ug/l	10

Respectfully Submitted,
Reviewed and Approved by:

Leon A. Peterson
Project Manager

1645 West 2200 South, Salt Lake City, Utah 84119 (801) 973-0050 FAX (801) 972-6278

Analytical Report

Mountain States Analytical
The Quality Solution

Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Attn: Mr. Robert Glascot
Project: HAFB 870

Sample ID: Site 870 Trip Blk 1/27/94
Matrix: Waste Water

MSAI Sample: 15466
MSAI Group: 3676
Date Reported: 01/31/94

Discard Date: 03/02/94
Date Submitted: 01/27/94
Date Sampled: 01/27/94
Collected by: RG
Purchase Order: Reanalysis
Project No.: 2208.0682

Test	Analysis	Results as Received	Units	Limit of Quantitation
4264	BTEX and Naphthalene			
	Method: 600/SW-846 602/8020			
	Benzene	< 1.0	ug/l	1.0
	Toluene	< 1.0	ug/l	1.0
	Ethylbenzene	< 1.0	ug/l	1.0
	m,p-Xylene	< 1.0	ug/l	1.0
	o-Xylene	< 1.0	ug/l	1.0
	Naphthalene	< 2.0	ug/l	2.0

Respectfully Submitted,
Reviewed and Approved by:

Leon A. Peterson
Project Manager

1645 West 2200 South, Salt Lake City, Utah 84119 (801) 973-0050 FAX (801) 972-6278

CHAIN OF CUSTODY RECORD/LAB WORK REQUEST

Chain of Custody Number 1
Cooler Number
Lot Control ID
Page 1 of 1
Air Bill No.

LABORATORY Mt. States

MONTGOMERY WATSON, INC.
Phone (801) 272-1900 FAX (801) 272-0430
MW Contact Bob Clark (RCD)
Project HAEB 870
Project Number 2208 0652
Date Due 48 hrs TAT See Lem Petit
Samplers Signature Robert C. Darby (RCD)

Lab ID No. (Lab Only)	Location ID	Sample ID	Depth Interval (ft)	Date Collected	Time Collected	Matrix¹	Sampling Technique²	Number of Containers (Total)	VOC	BNAE	Pest/PCB	Dioxin/Furan	TPH MOD	Metals	Cyanide	TCLP-Metals VOC BNAE Pest.	BTEXN				
	Site 870	MW-3		1/27/94	1318	WG	G	2									X				
		MW-20		1/27/94	1415	WG	G	2									X				
		MW-1		1/27/94	1516	WG	G	2									X				
		MW-8		1/27/94	1645	WG	G	2									X				
	Trip Blank 1/27/94			1/27/94	—	—	—	2									X				

¹ Matrix:
SO- Soil
SE - Sediment
WS - Surface Water
WG - Ground Water
LF - Product
AA - Air
SW - Wipe
DC - Drum Solids
LD- Drum Liquids
EP/TCLP Leachate

² Sampling Technique:
Composite=C
Grab=G

SPECIAL INSTRUCTIONS (i.e. metals list...):
Note: Rush Analyses 48hr. TAT

Relinquished by	Received by	Date	Time	Relinquished by	Received by	Date	Time
Robert C. Darby	[illegible]	1/27/94	1741				

LABORATORY USE ONLY

SAMPLES WERE:
1 Shipped or hand delivered
Notes:
2 Ambient or Chilled
Notes:
3 Temperature
4 Received Broken/Leaking (Improperly Sealed)
Y N
Notes:
5 Properly Preserved
Y N
Notes:
6 Received Within Holding Times
Y N
Notes

COC Tape Was:
1 Present on Outer Package
Y N NA
2 Unbroken on Outer Package
Y N NA
3 Present on Sample
Y N NA
4 Unbroken on Sample
Y N NA
Notes:

Discrepancies Between Sample Labels and COC Record?
Y N
Notes:

Invoice No.	202567
Invoice Date	01/31/9.
Page:	1 o.

Mountain States Analytical

The Quality Solution

Mr. Robert Glascot
Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Salt Lake City, UT 84124
Suite 200

Project Name:	HAFB 870
Project Number:	2208.0682
Purchase Order:	Reanalysis
Samples Received:	01/27/94
Date Reported:	01/31/94
Turnaround Time:	4 days
Reported To:	Mr. Robert Glascot

Analyses Performed

MSAI Group Number: 3676

See Analysis Reference Table Below

Sample I.D.	Date Sampled	Analyses	List Price	Rush Charges	Discount	Extended Price
15462 Site 870 MW-3	01/27/94	4264	90.00		90.00	0.00
15463 Site 870 MW-20	01/27/94	4264	90.00		90.00	0.00
15464 Site 870 MW-1	01/27/94	4264	90.00		90.00	0.00
15465 Site 870 MW-8	01/27/94	4264	90.00		90.00	0 00
15466 Site 870 Trip Blk 1/27/94	01/27/94	4264	90.00		90.00	0.00

Total Price $ 0.00

Analysis Reference Table

Analysis No.	Analysis Name	Matrix	Method	# of Tests	Unit List Price	Unit Rush Charges	Unit Discount Amount	Unit Net Price	Extended Price
4264	BTEX and Naphthalene	WW	600/SW-846 602/802	5	90.00		90.00	0.00	0.00

Total Price $ 0.00

Pricing Summary

Extended List Price	$	450.00
Total Rush Charges	$	0.00
Total Discount	$(	450.00)
TOTAL AMOUNT DUE	$	0.00

1645 West 2200 South, Salt Lake City, Utah 84119 (801) 973-0050 FAX (801) 972-6278

Mountain States Analytical

February 2, 1994

RECEIVED
FEB 04 1994

Mr. Robert Glascot
Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Reference:
Project: HAFB 870
Project No.: 2208.0682
MSAI Group: 3686

Dear Mr. Glascot:

Enclosed are the analytical results for your project referenced above. The following samples are included in the report.

Site 870 MW-5	Site 870 MW-4
Site 870 MW-6	Site 870 MW-2
Site 870 MW-16	Site 870 Trip Blk 1/28/94

All holding times were met for the tests performed on these samples.

If the report is acceptable, please approve the enclosed invoice and forward it for payment.

Thank you for selecting Mountain States Analytical, Inc. to serve as your analytical laboratory on this project. If you have any questions concerning these results, please feel free to contact me at any time.

We look forward to working with you on future projects.

With Regards,

Leon A. Peterson
Project Manager

Analytical Report

Mountain States Analytical
The Quality Solution

Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Attn: Mr. Robert Glascot
Project: HAFB 870

Sample ID: Site 870 MW-5
Matrix: Waste Water

MSAI Sample: 15487
MSAI Group: 3686
Date Reported: 02/02/94

Discard Date: 03/04/94
Date Submitted: 01/28/94
Date Sampled: 01/28/94
Collected by: RG
Purchase Order:
Project No.: 2208.0682

Test	Analysis	Results as Received	Units	Limit of Quantitation
4264	BTEX and Naphthalene			
	Method: 600/SW-846 602/8020			
	Benzene	416	ug/l	50
	Toluene	250	ug/l	50
	Ethylbenzene	246	ug/l	50
	m,p-Xylene	1,870	ug/l	50
	o-Xylene	638	ug/l	50
	Naphthalene	< 100	ug/l	100

Respectfully Submitted,
Reviewed and Approved by:

Leon A. Peterson
Project Manager

Analytical Report

Mountain States Analytical
The Quality Solution

Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Attn: Mr. Robert Glascot
Project: HAFB 870

Sample ID: Site 870 MW-4
Matrix: Waste Water

MSAI Sample: 15488
MSAI Group: 3686
Date Reported: 02/02/94

Discard Date: 03/04/94
Date Submitted: 01/28/94
Date Sampled: 01/28/94
Collected by: RG
Purchase Order:
Project No.: 2208.0682

Test	Analysis	Results as Received	Units	Limit of Quantitation
4264	BTEX and Naphthalene			
	Method: 600/SW-846 602/8020			
	Benzene	930	ug/l	50
	Toluene	1,830	ug/l	50
	Ethylbenzene	450	ug/l	50
	m,p-Xylene	3,670	ug/l	50
	o-Xylene	1,450	ug/l	50
	Naphthalene	< 100	ug/l	100

Respectfully Submitted,
Reviewed and Approved by:

Leon A. Peterson
Project Manager

Analytical Report

Mountain States Analytical
The Quality Solution

MSAI Sample:	15489
MSAI Group:	3686
Date Reported:	02/02/94
Discard Date:	03/04/94
Date Submitted:	01/28/94
Date Sampled:	01/28/94
Collected by:	RG
Purchase Order:	
Project No.:	2208.0682

Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Attn: Mr. Robert Glascot
Project: HAFB 870

Sample ID: Site 870 MW-6
Matrix: Waste Water

Test	Analysis	Results as Received	Units	Limit of Quantitation
4264	BTEX and Naphthalene			
	Method: 600/SW-846 602/8020			
	Benzene	24.5	ug/l	1.0
	Toluene	10.1	ug/l	1.0
	Ethylbenzene	18.6	ug/l	1.0
	m,p-Xylene	113	ug/l	1.0
	o-Xylene	42.9	ug/l	1.0
	Naphthalene	59.1	ug/l	2.0

Respectfully Submitted,
Reviewed and Approved by:

Leon A. Peterson
Project Manager

Analytical Report

Mountain States Analytical
The Quality Solution

Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Attn: Mr. Robert Glascot
Project: HAFB 870

Sample ID: Site 870 MW-2
Matrix: Waste Water

MSAI Sample: 15490
MSAI Group: 3686
Date Reported: 02/02/94

Discard Date: 03/04/94
Date Submitted: 01/28/94
Date Sampled: 01/28/94
Collected by: RG
Purchase Order:
Project No.: 2208.0682

Test	Analysis	Results as Received	Units	Limit of Quantitation
4264	BTEX and Naphthalene			
	Method: 600/SW-846 602/8020			
	Benzene	51.0	ug/l	5.0
	Toluene	56.3	ug/l	5.0
	Ethylbenzene	73.3	ug/l	5.0
	m,p-Xylene	500	ug/l	5.0
	o-Xylene	276	ug/l	5.0
	Naphthalene	85	ug/l	10

Respectfully Submitted,
Reviewed and Approved by:

Leon A. Peterson
Project Manager

Analytical Report

Mountain States Analytical
The Quality Solution

MSAI Sample:	15491
MSAI Group:	3686
Date Reported:	02/02/94
Discard Date:	03/04/94
Date Submitted:	01/28/94
Date Sampled:	01/28/94
Collected by:	RG
Purchase Order:	
Project No.:	2208.0682

Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Attn: Mr. Robert Glascot
Project: HAFB 870

Sample ID: Site 870 MW-16
Matrix: Waste Water

Test	Analysis	Results as Received	Units	Limit of Quantitation
4264	BTEX and Naphthalene			
	Method: 600/SW-846 602/8020			
	Benzene	49.4	ug/l	1.0
	Toluene	9.8	ug/l	1.0
	Ethylbenzene	70.1	ug/l	1.0
	m,p-Xylene	660	ug/l	50
	o-Xylene	344	ug/l	50
	Naphthalene	95.5	ug/l	2.0

Respectfully Submitted,
Reviewed and Approved by:

Leon A. Peterson
Project Manager

Analytical Report

Mountain States Analytical
The Quality Solution

MSAI Sample: 15492
MSAI Group: 3686
Date Reported: 02/02/94

Discard Date: 03/04/94
Date Submitted: 01/28/94
Date Sampled: 01/28/94
Collected by: RG
Purchase Order:
Project No.: 2208.0682

Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Attn: Mr. Robert Glascot
Project: HAFB 870

Sample ID: Site 870 Trip Blk 1/28/94
Matrix: Waste Water

Test	Analysis	Results as Received	Units	Limit of Quantitation
4264	BTEX and Naphthalene			
	Method: 600/SW-846 602/8020			
	Benzene	< 1.0	ug/l	1.0
	Toluene	< 1.0	ug/l	1.0
	Ethylbenzene	< 1.0	ug/l	1.0
	m,p-Xylene	< 1.0	ug/l	1.0
	o-Xylene	< 1.0	ug/l	1.0
	Naphthalene	< 2.0	ug/l	2.0

Respectfully Submitted,
Reviewed and Approved by:

Leon A. Peterson
Project Manager

CHAIN OF CUSTODY RECORD/LAB WORK REQUEST

Chain of Custody Number 2
Cooler Number —
Lot Control ID —
Page 1 of 1
Air Bill No. —

LABORATORY Mt. States

MONTGOMERY WATSON, INC.
Phone (801) 272-1900 FAX (801) 272-0430
MW Contact Bob Glascott
Project HAFB 870
Project Number 2206.0482
Date Due RUSH 48 TAT
Samplers Signature [illegible] (RAH)

Lab ID No. (Lab Only)	Location ID	Sample ID	Depth Interval (ft)	Date Collected	Time Collected	Matrix[1]	Sampling Technique[2]	Number of Containers (Total)	VOC	BNAE	Pest/PCB	Dioxin/Furan	TPH MOD	Metals	Cyanide	TCLP-Metals VOC BNAE Pest.	BTEXN				
	Site 870	MW-5		1/28/94	0930	WG	G	2									X				
		MW-4		1/28/94	1035	WG	G	2									X				
		MW-6		1/28/94	1210	WG	G	2									X				
		MW-2		1/28/94	1400	WG	G	2									X				
		MW-16		1/28/94	1515	WG	G	2									X				
		Trip Blank 1/28/94		—	—	—	—	2									X				

[1] Matrix:
SO- Soil
SE - Sediment
WS - Surface Water
WG - Ground Water
LF - Product
AA - Air
SW - Wipe
DC - Drum Solids
LD- Drum Liquids
EP/TCLP Leachate

[2] Sampling Technique:
Composite=C
Grab=G

SPECIAL INSTRUCTIONS (i.e. metals list...):
Note: Rush 48hr TAT
Cooler temp = 7.9°C

Relinquished by	Received by	Date	Time	Relinquished by	Received by	Date	Time
[illegible signature]	[illegible signature]	1/28/94	1620				

LABORATORY USE ONLY

SAMPLES WERE:
1 Shipped or hand delivered
Notes:
2 Ambient or Chilled
Notes:
3 Temperature ______
4 Received Broken/Leaking (Improperly Sealed)
Y N
Notes
5 Properly Preserved
Y N
Notes:
6 Received Within Holding Times
Y N
Notes:

COC Tape Was:
1 Present on Outer Package
Y N NA
2 Unbroken on Outer Package
Y N NA
3 Present on Sample
Y N NA
4 Unbroken on Sample
Y N NA
Notes:

Discrepancies Between Sample Labels and COC Record?
Y N
Notes:

Invoice No. 202598
Invoice Date 02/02/94
Page: 1 of 1

Mountain States Analytical
The Quality Solution

Project Name: HAFB 870
Project Number: 2208.0682
Purchase Order:
Samples Received: 01/28/94
Date Reported: 02/02/94
Turnaround Time: 5 days
Reported To: Mr. Robert Glascot

Mr. Robert Glascot
Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Salt Lake City, UT 84124
Suite 200

Analyses Performed
See Analysis Reference Table Below

MSAI Group Number: 3686

Sample I.D.	Date Sampled	Analyses	List Price	Rush Charges	Discount	Extended Price
15487 Site 870 MW-5	01/28/94	4264	90.00		90.00	0.00
15488 Site 870 MW-4	01/28/94	4264	90.00		90.00	0.00
15489 Site 870 MW-6	01/28/94	4264	90.00		90.00	0.00
15490 Site 870 MW-2	01/28/94	4264	90.00		90.00	0.00
15491 Site 870 MW-16	01/28/94	4264	90.00		90.00	0.00
15492 Site 870 Trip Blk 1/28/94	01/28/94	4264	90.00		90.00	0.00

Total Price $ 0.00

Analysis Reference Table

Analysis No.	Analysis Name	Matrix	Method	# of Tests	Unit List Price	Unit Rush Charges	Unit Discount Amount	Unit Net Price	Extended Price
4264	BTEX and Naphthalene	WW	600/SW-846 602/802	6	90.00		90.00	0.00	0.00

Total Price $ 0.00

Pricing Summary

Extended List Price	$	540.00
Total Rush Charges	$	0.00
Total Discount	$	(540.00)
TOTAL AMOUNT DUE	$	0.00

Mountain States Analytical

January 6, 1994

Mr. Robert Glascot
Montgomery Watson Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, Utah 84124

re: MSAI groups 3474, 3465, 3452, 3439 Nitrite Results

Bob,

Pursuant to our conservation January 5, 1993 I have researched the Nitrite values for the above mentioned groups. If you would prefer the analytical groups be resubmitted with the following values please contact me. The nitrite results are as follows:

3474-14774	<0.01 mg/l Nitrite
3474-14775	<0.01 mg/l Nitrite
3474-14776	N/R on sample
3465-14748	<0.01 mg/l Nitrite
3465-14749	0.637 mg/l Nitrite
3465-14750	<0.01 mg/l Nitrite
3465-14751	N/R on sample
3452-14700	<0.01 mg/l Nitrite
3452-14701	0.025 mg/l Nitrite
3452-14702	0.031 mg/l Nitrite
3452-14703	N/R on sample
3439-14663	0.021 mg/l Nitrite
3439-14664	0.037 mg/l Nitrite
3439-14665	0.187 mg/l Nitrite
3439-14666	0.577 mg/l Nitrite - MW-9
3439-14667	N/R on sample

Bob if you need any further information from me please do not hesitate to contact me at (801) 973-0050.

Best regards,

Leon A. Peterson

Leon A. Peterson

Mountain States Analytical

January 18, 1994

Mr. Robert Glascot
Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Reference:
Project: 870 - Hill AFB
Project No.: 2208-0652
MSAI Group: 3474

Dear Mr. Glascot:

Enclosed are the analytical results for your project referenced above. The following samples are included in the report.

870 MW-20 870 MW-1 Trip Blank

All holding times were met for the tests performed on these samples.

If the report is acceptable, please approve the enclosed invoice and forward it for payment.

Thank you for selecting Mountain States Analytical, Inc. to serve as your analytical laboratory on this project. If you have any questions concerning these results, please feel free to contact me at any time.

We look forward to working with you on future projects.

With Regards,

Leon A. Peterson
Project Manager

Analytical Report

Mountain States Analytical
The Quality Solution

MSAI Sample:	14775
MSAI Group:	3474
Date Reported:	01/06/94
Discard Date:	02/05/94
Date Submitted:	12/21/93
Date Sampled:	12/21/93
Collected by:	MA
Purchase Order:	
Project No.:	2208-0652

Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Attn: Mr. Robert Glascot
Project: 870 - Hill AFB

Sample ID: 870 MW-1
Matrix: Waste Water

Test	Analysis	Results as Received	Units	Limit of Quantitation
7254	Iron by ICP	10.8	mg/l	0.10
	Method: SW-846 6010			
0219	Nitrogen, Nitrate/Nitrite	< 0.05	mg/l	0.05
	Method: EPA 353.3			
1125	Sulfate, Turbidimetric	2	mg/l	2
	Method: EPA 375.4			
0976	Drinking water volatiles			
	Method: EPA 524.2			
	Ethylbenzene	250	ug/l	(1) 12
	Toluene	130	ug/l	12
	o-Xylene	280	ug/l	12
	Naphthalene	< 12	ug/l	12
	1,2,4-Trimethylbenzene (Pseudocumen	680	ug/l	12
	1,3,5-Trimethylbenzene	330	ug/l	12
	Benzene	480	ug/l	12
	m,p-Xylene	850	ug/l	12

(1) Due to high target compound level(s), dilution was required. The LCQ was raised accordingly.

Respectfully Submitted,
Reviewed and Approved by

Leon A. Peterson
Project Manager

1645 West 2200 South, Salt Lake City, Utah 84119 (801) 973-0050 FAX (801) 972-6278

Analytical Report

Mountain States Analytical
The Quality Solution

Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Attn: Mr. Robert Glascot
Project: 870 - Hill AFB

Sample ID: 870 MW-20
Matrix: Waste Water

MSAI Sample: 14774
MSAI Group: 3474
Date Reported: 01/06/94

Discard Date: 02/05/94
Date Submitted: 12/21/93
Date Sampled: 12/21/93
Collected by: MA
Purchase Order:
Project No.: 2208-0652

Test	Analysis	Results as Received	Units	Limit of Quantitation
7254	Iron by ICP Method: SW-846 6010	11.4	mg/l	0.10
0219	Nitrogen, Nitrate/Nitrite Method: EPA 353.3	< 0.05	mg/l	0.05
1125	Sulfate, Turbidimetric Method: EPA 375.4	3	mg/l	2
0976	Drinking water volatiles Method: EPA 524.2			
	Ethylbenzene	< 12	ug/l	(1) 12
	Toluene	60	ug/l	12
	o-Xylene	120	ug/l	12
	Naphthalene	88	ug/l	12
	1,2,4-Trimethylbenzene (Pseudocumen	< 12	ug/l	12
	1,3,5-Trimethylbenzene	100	ug/l	12
	Benzene	220	ug/l	12
	m,p-Xylene	< 12	ug/l	12

(1) Due to high target compound level(s), dilution was required. The LOQ was raised accordingly.

Respectfully Submitted,
Reviewed and Approved by:

Leon A. Peterson
Project Manager

Mountain States Analytical

January 18, 1994

Mr. Robert Glascot
Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Reference:
Project: Hill AFB - 870
Project No.: 2208-0652
MSAI Group: 3465

Dear Mr. Glascot:

Enclosed are the analytical results for your project referenced above. The following samples are included in the report.

870 MW-8 870 MW-4 870 MW-2
Trip Blank

All holding times were met for the tests performed on these samples.

If the report is acceptable, please approve the enclosed invoice and forward it for payment.

Thank you for selecting Mountain States Analytical, Inc. to serve as your analytical laboratory on this project. If you have any questions concerning these results, please feel free to contact me at any time.

We look forward to working with you on future projects.

With Regards,

Leon A. Peterson
Project Manager

Analytical Report

Mountain States Analytical
The Quality Solution

Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Attn: Mr. Robert Glascot
Project: Hill AFB - 870

Sample ID: 870 MW-2
Matrix: Waste Water

MSAI Sample: 14750
MSAI Group: 3465
Date Reported: 01/06/94

Discard Date: 02/05/94
Date Submitted: 12/21/93
Date Sampled: 12/20/93
Collected by: WA
Purchase Order:
Project No.: 2208-0652

Test	Analysis	Results as Received	Units	Limit of Quantitation
7254	Iron by ICP	50.5	mg/l	0.10
	Method: SW-846 6010			
0219	Nitrogen, Nitrate/Nitrite	0.25	mg/l	0.05
	Method: EPA 353.3			
1125	Sulfate, Turbidimetric	40	mg/l	2
	Method: EPA 375.4			
0976	Drinking water volatiles			
	Method: EPA 524.2			
	Ethylbenzene	170	ug/l	(1) 25
	Toluene	330	ug/l	25
	o-Xylene	550	ug/l	25
	Naphthalene	160	ug/l	25
	1,2,4-Trimethylbenzene (Pseudocumen	750	ug/l	25
	1,3,5-Trimethylbenzene	350	ug/l	25
	Benzene	120	ug/l	25
	m,p-Xylene	1,300	ug/l	25

(1) Due to high target compound level(s), dilution was required. The LOQ was raised accordingly.

Respectfully Submitted,
Reviewed and Approved by:

Leon A. Peterson
Project Manager

Analytical Report

Mountain States Analytical
The Quality Solution

MSAI Sample: 14748
MSAI Group: 3465
Date Reported: 01/06/94

Discard Date: 02/05/94
Date Submitted: 12/21/93
Date Sampled: 12/20/93
Collected by: WA
Purchase Order:
Project No.: 2208-0652

Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Attn: Mr. Robert Glascot
Project: Hill AFB - 870

Sample ID: 870 MW-8
Matrix: Waste Water

Test	Analysis	Results as Received	Units	Limit of Quantitation
7254	Iron by ICP Method: SW-846 6010	5.22	mg/l	0.10
0219	Nitrogen, Nitrate/Nitrite Method: EPA 353.3	0.28	mg/l	0.05
0125	Sulfate, Turbidimetric Method: EPA 375.4	11	mg/l	2
0976	Drinking water volatiles Method: EPA 524.2			
	Ethylbenzene	< 12	ug/l	(1) 12
	Toluene	< 12	ug/l	12
	o-Xylene	< 12	ug/l	12
	Naphthalene	300	ug/l	12
	1,2,4-Trimethylbenzene (Pseudocumen	280	ug/l	12
	1,3,5-Trimethylbenzene	140	ug/l	12
	Benzene	28	ug/l	12
	m,p-Xylene	190	ug/l	12

(1) Due to high target compound level(s), dilution was required. The LOQ was raised accordingly.

Respectfully Submitted,
Reviewed and Approved by:

Leon A. Peterson
Project Manager

Analytical Report

Mountain States Analytical
The Quality Solution

MSAI Sample:	14749
MSAI Group:	3465
Date Reported:	01/06/94
Discard Date:	02/05/94
Date Submitted:	12/21/93
Date Sampled:	12/20/93
Collected by:	WA
Purchase Order:	
Project No.:	2208-0652

Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Attn: Mr. Robert Glascot
Project: Hill AFB - 870

Sample ID: 870 MW-4
Matrix: Waste Water

Test	Analysis	Results as Received	Units	Limit of Quantitation
7254	Iron by ICP Method: SW-846 6010	13.6	mg/l	0.10
0219	Nitrogen, Nitrate/Nitrite Method: EPA 353.3	2.32	mg/l	0.05
1125	Sulfate, Turbidimetric Method: EPA 375.4	< 2	mg/l	2
0976	Drinking water volatiles Method: EPA 524.2			
	Ethylbenzene	550	ug/l	(1) 120
	Toluene	2,300	ug/l	120
	o-Xylene	1,500	ug/l	120
	Naphthalene	< 120	ug/l	120
	1,2,4-Trimethylbenzene (Pseudocumen	1,500	ug/l	120
	1,3,5-Trimethylbenzene	550	ug/l	120
	Benzene	1,500	ug/l	120
	m,p-Xylene	4,300	ug/l	120

(1) Due to high target compound level(s), dilution was required. The LOQ was raised accordingly.

Respectfully Submitted,
Reviewed and Approved by:

Leon A. Peterson
Project Manager

Mountain States Analytical

January 18, 1994

Mr. Robert Glascot
Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Reference:
Project: UST 870
MSAI Group: 3452

Dear Mr. Glascot:

Enclosed are the analytical results for your project referenced above. The following samples are included in the report.

870 MW-5 870 MW-3 870 MW-6
Trip Blank

All holding times were met for the tests performed on these samples except:

Sample - (Sample Date) Test Description	Expiration Date	Date Analyzed	Days Past Holding Time
870 MW-5 - (12/17/93) Nitrogen, Nitrate/Nitrite	12/19/93	12/20/93	1
870 MW-3 - (12/17/93) Nitrogen, Nitrate/Nitrite	12/19/93	12/20/93	1
870 MW-6 - (12/17/93) Nitrogen, Nitrate/Nitrite	12/19/93	12/20/93	1

If the report is acceptable, please approve the enclosed invoice and forward it for payment.

Thank you for selecting Mountain States Analytical, Inc. to serve as your analytical laboratory on this project. If you have any questions concerning these results, please feel free to contact me at any time.

We look forward to working with you on future projects.

With Regards,

Leon A. Peterson
Project Manager

Analytical Report

Mountain States Analytical
The Quality Solution

MSAI Sample:	14701
MSAI Group:	3452
Date Reported:	01/05/94
Discard Date:	02/04/94
Date Submitted:	12/20/93
Date Sampled:	12/17/93
Collected by:	BG
Purchase Order:	
Project No.:	

Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Attn: Mr. Robert Glascot
Project: UST 870

Sample ID: 870 MW-3
Matrix: Waste Water

Test	Analysis	Results as Received	Units	Limit of Quantitation
7254	Iron by ICP	8.20	mg/l	0.10
	Method: SW-846 6010			
0219	Nitrogen, Nitrate/Nitrite	< 0.05	mg/l	0.05
	Method: EPA 353.3			
1125	Sulfate, Turbidimetric	< 2	mg/l	2
	Method: EPA 375.4			
0976	Drinking water volatiles			
	Method: EPA 524.2			
	Ethylbenzene	450	ug/l	(1) 25
	Toluene	1,550	ug/l	25
	o-Xylene	1,500	ug/l	25
	Naphthalene	140	ug/l	25
	1,2,4-Trimethylbenzene (Pseudocumen	1,000	ug/l	25
	1,3,5-Trimethylbenzene	480	ug/l	25
	Benzene	4,300	ug/l	25
	m,p-Xylene	4,300	ug/l	25

(1) Due to high target compound level(s), dilution was required. The LOQ was raised accordingly.

Respectfully Submitted,
Reviewed and Approved by:

Leon A. Peterson
Project Manager

Analytical Report

Mountain States Analytical

The Quality Solution

Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Attn: Mr. Robert Glascot
Project: UST 870

Sample ID: 870 MW-5
Matrix: Waste Water

MSAI Sample: 14700
MSAI Group: 3452
Date Reported: 01/05/94

Discard Date: 02/04/94
Date Submitted: 12/20/93
Date Sampled: 12/17/93
Collected by: BG
Purchase Order:
Project No.:

Test	Analysis	Results as Received	Units		Limit of Quantitation
7254	Iron by ICP Method: SW-846 6010	6.41	mg/l		0.10
0219	Nitrogen, Nitrate/Nitrite Method: EPA 353.3	< 0.05	mg/l		0.05
1125	Sulfate, Turbidimetric Method: EPA 375.4	< 2	mg/l		2
0976	Drinking water volatiles Method: EPA 524.2				
	Ethylbenzene	330	ug/l	(1)	25
	Toluene	430	ug/l		25
	o-Xylene	900	ug/l		25
	Naphthalene	110	ug/l		25
	1,2,4-Trimethylbenzene (Pseudocumen	960	ug/l		25
	1,3,5-Trimethylbenzene	450	ug/l		25
	Benzene	800	ug/l		25
	m,p-Xylene	2,750	ug/l		25

(1) Due to high target compound level(s), dilution was required. The LOQ was raised accordingly.

Respectfully Submitted,
Reviewed and Approved by:

Leon A. Peterson
Project Manager

1645 West 2200 South, Salt Lake City, Utah 84119 (801) 973-0050 FAX (801) 972-6278

Analytical Report

Mountain States Analytical
The Quality Solution

MSAI Sample:	14702
MSAI Group:	3452
Date Reported:	01/05/94
Discard Date:	02/04/94
Date Submitted:	12/20/93
Date Sampled:	12/17/93
Collected by:	BG
Purchase Order:	
Project No.:	

Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Attn: Mr. Robert Glascot
Project: UST 870

Sample ID: 870 MW-6
Matrix: Waste Water

Test	Analysis	Results as Received	Units	Limit of Quantitation
7254	Iron by ICP Method: SW-846 6010	10.3	mg/l	0.10
0219	Nitrogen, Nitrate/Nitrite Method: EPA 353.3	0.07	mg/l	0.05
1125	Sulfate, Turbidimetric Method: EPA 375.4	21	mg/l	2
0976	Drinking water volatiles Method: EPA 524.2			
	Ethylbenzene	< 120	ug/l	(1) 120
	Toluene	< 120	ug/l	120
	o-Xylene	450	ug/l	120
	Naphthalene	580	ug/l	120
	1,2,4-Trimethylbenzene (Pseudocumen	1,500	ug/l	120
	1,3,5-Trimethylbenzene	650	ug/l	120
	Benzene	280	ug/l	120
	m,p-Xylene	1,300	ug/l	120

(1) Due to high target compound level(s), dilution was required. The LOQ was raised accordingly

Respectfully Submitted,
Reviewed and Approved by:

Leon A. Peterson
Project Manager

Analytical Report

Mountain States Analytical
The Quality Solution

MSAI Sample: 14703
MSAI Group: 3452
Date Reported: 01/05/94

Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Discard Date: 02/04/94
Date Submitted: 12/20/93
Date Sampled: 12/17/93
Collected by: BG
Purchase Order:
Project No.:

Attn: Mr. Robert Glascot
Project: UST 870

Sample ID: Trip Blank
Matrix: Waste Water

Test	Analysis	Results as Received	Units	Limit of Quantitation
0976	Drinking water volatiles			
	Method: EPA 524.2			
	Ethylbenzene	< 0.5	ug/l	0.5
	Toluene	< 0.5	ug/l	0.5
	o-Xylene	< 0.5	ug/l	0.5
	Naphthalene	< 0.5	ug/l	0.5
	1,2,4-Trimethylbenzene (Pseudocumen	< 0.5	ug/l	0.5
	1,3,5-Trimethylbenzene	< 0.5	ug/l	0.5
	Benzene	< 0.5	ug/l	0.5
	m,p-Xylene	< 0.5	ug/l	0.5

Respectfully Submitted,
Reviewed and Approved by:

Leon A. Peterson
Project Manager

Analytical Report

Mountain States Analytical
The Quality Solution

Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Attn: Mr. Robert Glascot
Project: Hill AFB - 870

Sample ID: Trip Blank
Matrix: Waste Water

MSAI Sample: 14751
MSAI Group: 3465
Date Reported: 01/06/94

Discard Date: 02/05/94
Date Submitted: 12/21/93
Date Sampled: 12/20/93
Collected by: WA
Purchase Order:
Project No.: 2208-0652

Test	Analysis	Results as Received	Units	Limit of Quantitation
0976	Drinking water volatiles			
	Method: EPA 524.2			
	Ethylbenzene	< 0.5	ug/l	0.5
	Toluene	< 0.5	ug/l	0.5
	o-Xylene	< 0.5	ug/l	0.5
	Naphthalene	< 0.5	ug/l	0.5
	1,2,4-Trimethylbenzene (Pseudocumen	< 0.5	ug/l	0.5
	1,3,5-Trimethylbenzene	< 0.5	ug/l	0.5
	Benzene	< 0.5	ug/l	0.5
	m,p-Xylene	< 0.5	ug/l	0.5

Respectfully Submitted,
Reviewed and Approved by:

Leon A. Peterson
Project Manager

1645 West 2200 South, Salt Lake City, Utah 84119 (801) 973-0050 FAX (801) 972-6278

Analytical Report

Mountain States Analytical
The Quality Solution

Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Attn: Mr. Robert Glascot
Project: 870 - Hill AFB

Sample ID: Trip Blank
Matrix: Waste Water

MSAI Sample: 14776
MSAI Group: 3474
Date Reported: 01/06/94

Discard Date: 02/05/94
Date Submitted: 12/21/93
Date Sampled: 12/21/93
Collected by: MA
Purchase Order:
Project No.: 2208-0652

Test	Analysis	Results as Received	Units	Limit of Quantitation
0976	Drinking water volatiles			
	Method: EPA 524.2			
	Ethylbenzene	< 0.5	ug/l	0.5
	Toluene	< 0.5	ug/l	0.5
	o-Xylene	< 0.5	ug/l	0.5
	Naphthalene	< 0.5	ug/l	0.5
	1,2,4-Trimethylbenzene (Pseudocumen	< 0.5	ug/l	0.5
	1,3,5-Trimethylbenzene	< 0.5	ug/l	0.5
	Benzene	< 0.5	ug/l	0.5
	m,p-Xylene	< 0.5	ug/l	0.5

Respectfully Submitted,
Reviewed and Approved by:

Leon A. Peterson
Project Manager

1645 West 2200 South. Salt Lake City, Utah 84119 (801) 973-0050 FAX (801) 972-6278

Mountain States Analytical

January 4, 1994

Mr. Robert Glascot
Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Reference:
Project: 870
Project No.: 2208-0652
MSAI Group: 3439

Dear Mr. Glascot:

Enclosed are the analytical results for your project referenced above. The following samples are included in the report.

870 MW-7	870 MW-13	870 MW-14
870 MW-9	870 Trip Blank	

All holding times were met for the tests performed on these samples.

If the report is acceptable, please approve the enclosed invoice and forward it for payment.

Thank you for selecting Mountain States Analytical, Inc. to serve as your analytical laboratory on this project. If you have any questions concerning these results, please feel free to contact me at any time.

We look forward to working with you on future projects.

With Regards,

Rolf E Larsen for

Leon A. Peterson
Project Manager

Analytical Report

Mountain States Analytical
The Quality Solution

Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Attn: Mr. Robert Glascot
Project: 870

Sample ID: 870 MW-7
Matrix: Waste Water

MSAI Sample: 14663
MSAI Group: 3439
Date Reported: 01/04/94

Discard Date: 02/03/94
Date Submitted: 12/17/93
Date Sampled: 12/16/93
Collected by: BG
Purchase Order:
Project No.: 2208-0652

Test	Analysis	Results as Received	Units		Limit of Quantitation
7254	Iron by ICP	1.36	mg/l		0.10
	Method: SW-846 6010				
0219	Nitrogen, Nitrate/Nitrite	11.8	mg/l		0.05
	Method: EPA 353.3				
1125	Sulfate, Turbidimetric	26	mg/l		2
	Method: EPA 375.4				
4264	BTEX and Naphthalene				
	Method: 600/SW-846 602/8020				
	Benzene	< 1.0	ug/l		1.0
	Toluene	< 1.0	ug/l		1.0
	Ethylbenzene	< 1.0	ug/l		1.0
	m,p-Xylene	< 1.0	ug/l		1.0
	o-Xylene	< 1.0	ug/l		1.0
	Naphthalene	< 2.0	ug/l		2.0
0976	Drinking water volatiles				
	Method: EPA 524.2				
	1,2,4-Trimethylbenzene (Pseudocumen	< 1	ug/l	(1)	1
	1,3,5-Trimethylbenzene	< 1	ug/l		1

(1) LOQ raised due to insufficient sample.

Respectfully Submitted,
Reviewed and Approved by:

Leon A. Peterson
Project Manager

Analytical Report

Mountain States Analytical
The Quality Solution

Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Attn: Mr. Robert Glascot
Project: 870

Sample ID: 870 MW-13
Matrix: Waste Water

MSAI Sample: 14664
MSAI Group: 3439
Date Reported: 01/04/94

Discard Date: 02/03/94
Date Submitted: 12/17/93
Date Sampled: 12/16/93
Collected by: BG
Purchase Order:
Project No.: 2208-0652

Test	Analysis	Results as Received	Units	Limit of Quantitation
7254	Iron by ICP	10.2	mg/l	0.10
	Method: SW-846 6010			
0219	Nitrogen, Nitrate/Nitrite	0.10	mg/l	0.05
	Method: EPA 353.3			
1125	Sulfate, Turbidimetric	3	mg/l	2
	Method: EPA 375.4			
4264	BTEX and Naphthalene			
	Method: 600/SW-846 602/8020			
	Benzene	2,690	ug/l	50
	Toluene	1,530	ug/l	50
	Ethylbenzene	589	ug/l	50
	m,p-Xylene	3,140	ug/l	50
	o-Xylene	1,140	ug/l	50
	Naphthalene	401	ug/l	100
0976	Drinking water volatiles			
	Method: EPA 524.2			
	1,2,4-Trimethylbenzene (Pseudocumen	1,100	ug/l	(1) 20
	1,3,5-Trimethylbenzene	470	ug/l	20

(1) Due to high non-target compound level(s), dilution was required. The LOQ was raised accordingly.

Respectfully Submitted,
Reviewed and Approved by:

Rolf E Larsen for

Leon A. Peterson
Project Manager

Analytical Report

Mountain States Analytical
The Quality Solution

MSAI Sample:	14665
MSAI Group:	3439
Date Reported:	01/04/94
Discard Date:	02/03/94
Date Submitted:	12/17/93
Date Sampled:	12/16/93
Collected by:	BG
Purchase Order:	
Project No.:	2208-0652

Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Attn: Mr. Robert Glascot
Project: 870

Sample ID: 870 MW-14
Matrix: Waste Water

Test	Analysis	Results as Received	Units	Limit of Quantitation
7254	Iron by ICP	5.96	mg/l	0.10
	Method: SW-846 6010			
0219	Nitrogen, Nitrate/Nitrite	1.91	mg/l	0.05
	Method: EPA 353.3			
1125	Sulfate, Turbidimetric	27	mg/l	2
	Method: EPA 375.4			
4264	BTEX and Naphthalene			
	Method: 600/SW-846 602/8020			
	Benzene	941	ug/l	50
	Toluene	2,800	ug/l	50
	Ethylbenzene	505	ug/l	50
	m,p-Xylene	4,050	ug/l	50
	o-Xylene	1,460	ug/l	50
	Naphthalene	187	ug/l	100
0976	Drinking water volatiles			
	Method: EPA 524.2			
	1,2,4-Trimethylbenzene (Pseudocumen	1,400	ug/l	(1) 20
	1,3,5-Trimethylbenzene	650	ug/l	20

(1) Due to high non-target compound level(s), dilution was required. The LOQ was raised accordinly.

Respectfully Submitted,
Reviewed and Approved by:

Ralf E Larsen for

Leon A. Peterson
Project Manager

1645 West 2200 South, Salt Lake City, Utah 84119 (801) 973-0050 FAX (801) 972-6278

Analytical Report

Mountain States Analytical
The Quality Solution

Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Attn: Mr. Robert Glascot
Project: 870

Sample ID: 870 MW-9
Matrix: Waste Water

MSAI Sample: 14666
MSAI Group: 3439
Date Reported: 01/04/94

Discard Date: 02/03/94
Date Submitted: 12/17/93
Date Sampled: 12/16/93
Collected by: BG
Purchase Order:
Project No.: 2208-0652

Test	Analysis	Results as Received	Units	Limit of Quantitation
7254	Iron by ICP	2.07	mg/l	0.10
	Method: SW-846 6010			
0219	Nitrogen, Nitrate/Nitrite	0.40	mg/l	0.05
	Method: EPA 353.3			
1125	Sulfate, Turbidimetric	22	mg/l	2
	Method: EPA 375.4			
4264	BTEX and Naphthalene			
	Method: 600/SW-846 602/8020			
	Benzene	72	ug/l	10
	Toluene	27	ug/l	10
	Ethylbenzene	35	ug/l	10
	m,p-Xylene	406	ug/l	10
	o-Xylene	152	ug/l	10
	Naphthalene	598	ug/l	20
3976	Drinking water volatiles			
	Method: EPA 524.2			
	1,2,4-Trimethylbenzene (Pseudocumen	650	ug/l	12
	1,3,5-Trimethylbenzene	190	ug/l	12

Respectfully Submitted,
Reviewed and Approved by:

Ralf E Larsen for

Leon A. Peterson
Project Manager

Analytical Report

Mountain States Analytical
The Quality Solution

Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Attn: Mr. Robert Glascot
Project: 870

Sample ID: 870 Trip Blank
Matrix: Waste Water

MSAI Sample: 14667
MSAI Group: 3439
Date Reported: 01/04/94

Discard Date: 02/03/94
Date Submitted: 12/17/93
Date Sampled: 12/15/93
Collected by: BG
Purchase Order:
Project No.: 2208-0652

Test	Analysis	Results as Received	Units		Limit of Quantitation
4264	BTEX and Naphthalene				
	Method: 600/SW-846 602/8020				
	Benzene	< 1.0	ug/l		1.0
	Toluene	< 1.0	ug/l		1.0
	Ethylbenzene	< 1.0	ug/l		1.0
	m,p-Xylene	< 1.0	ug/l		1.0
	o-Xylene	< 1.0	ug/l		1.0
	Naphthalene	< 2.0	ug/l		2.0
0976	Drinking water volatiles				
	Method: EPA 524.2				
	1,2,4-Trimethylbenzene (Pseudocumen	< 1	ug/l	(1)	1
	1,3,5-Trimethylbenzene	< 1	ug/l		1

(1) LOQ raised due to insufficient sample.

Respectfully Submitted,
Reviewed and Approved by:

Leon A. Peterson
Project Manager

Invoice

Invoice No. 202400
Invoice Date 01/04/94
Page: 1 of

Mountain States Analytical
The Quality Solution

Project Name: 870
Project Number: 2208-0652
Purchase Order:
Samples Received: 12/17/93
Date Reported: 01/04/94
Turnaround Time: 18 days
Reported To: Mr. Robert Glascot

Mr. Robert Glascot
Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Salt Lake City, UT 84124
Suite 200

Analyses Performed

MSAI Group Number: 3439

See Analysis Reference Table Below

Sample I.D.	Date Sampled	Analyses	List Price	Rush Charges	Discount	Extended Price
14663 870 MW-7	12/16/93	0001F 0219 03921 0976 1125 4264 7254	534.00		80.10	453.9
14664 870 MW-13	12/16/93	0001F 0219 03921 0976 1125 4264 7254	534.00		80.10	453.9
14665 870 MW-14	12/16/93	0001F 0219 03921 0976 1125 4264 7254	534.00		80.10	453.9
14666 870 MW-9	12/16/93	0001F 0219 03921 0976 1125 4264 7254	534.00		80.10	453.9
14667 870 Trip Blank	12/15/93	0001F 0976 4264	465.00		69.75	395.2

Total Price $ 2,210.8

Analysis Reference Table

Analysis No.	Analysis Name	Matrix	Method	# of Tests	Unit List Price	Unit Rush Charges	Unit Discount Amount	Unit Net Price	Extended Price
0001F	Special Instructions, GC/MS VOA		SPECIAL INST. MSAI	5	0.00		0.00	0.00	0.0
0219	Nitrogen, Nitrate/Nitrite	WA	EPA 353.3	4	15.00		2.25	12.75	51.0
03921	Flame/ICP Prep for Metals, Waters	WW	SW-846 3005	4	15.00		2.25	12.75	51.0
0976	Drinking water volatiles	WA	EPA 524.2	5	375.00		56.25	318.75	1,593.7
1125	Sulfate, Turbidimetric	WW	EPA 375.4	4	25.00		3.75	21.25	85.0
4264	BTEX and Naphthalene	WW	600/SW-846 602/802	5	90.00		13.50	76.50	382.5
7254	Iron by ICP	WW	SW-846 6010	4	14.00		2.10	11.90	47.6

Total Price $ 2,210.8

Pricing Summary

Extended List Price	$	2,601.0
Total Rush Charges	$	0.0
Total Discount	$(	390.1

TOTAL AMOUNT DUE $ 2,210.8

CHAIN OF CUSTODY RECORD/LAB WORK REQUEST

Chain of Custody Number 1
Cooler Number —
Lot Control ID —
Page 1 of 1
Air Bill No. —

LABORATORY Mt. State Analytical

MONTGOMERY WATSON, INC.
Phone (801) 272-1900 FAX (801) 272-0430
MW Contact Bob Hancot
Project 870
Project Number 2208-0652
Date Due
Samplers Signature [signature]

Lab ID No. (Lab Only)	Location ID	Sample ID	Depth Interval (ft)	Date Collected	Time Collected	Matrix[1]	Sampling Technique[2]	Number of Containers (Total)	VOC/BTEX N 123/124,135-TMB	BNAE	Pest/PCB	Dioxin/Furan	TPH MOD	Metals	Cyanide	TCLP-Metals VOC BNAE Pest.	Fe+2/Fe+3 (Total Fe)	METHANE	NO2/NO3 SO4		
	870	MW-7	~~0~~ yes	12-16	1105	GW	G	7	X								X	X	X		
	870	MW-13	~~0~~ yes	12-16	1240	GW	G	7	X								X	X	X		
	870	MW-14	~~0~~ yes	12-16	1510	GW	G	7	X								X	X	X		
	870	MW-9	~~0~~ yes	12-16	1445	GW	G	7	X								X	X	X		
	870	Trip Blank 12/16/93	yes	12-16				2	X												

MW 7 had only 2 vials & no NO3 pre 12/17/93

[1] Matrix:
SO - Soil
SE - Sediment
WS - Surface Water
WG - Ground Water
LF - Product
AA - Air
SW - Wipe
DC - Drum Solids
LD - Drum Liquids
EP/TCLP Leachate

[2] Sampling Technique:
Composite=C
Grab=G

SPECIAL INSTRUCTIONS (i.e. metals list...):

Relinquished by	Received by	Date	Time	Relinquished by	Received by	Date	Time
[signature]	B.C.	12-16-93	1740				
[signature]	Paul Kelly	12/16/93	1545				

LABORATORY USE ONLY

SAMPLES WERE:

1 Shipped or hand delivered
Notes:

2 Ambient or Chilled
Notes

3 Temperature ____

4 Received Broken/Leaking (Improperly Sealed)
Y N
Notes

5 Properly Preserved
Y N
Notes

6 Received Within Holding Times
Y N
Notes

COC Tape Was:

1 Present on Outer Package
Y N NA

2 Unbroken on Outer Package
Y N NA

3 Present on Sample
Y N NA

4 Unbroken on Sample
Y N NA
Notes

Discrepancies Between Sample Labels and COC Record?
Y N
Notes

Mountain States Analytical

January 6, 1994

Mr. Robert Glascot
Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Reference:
Project: 870 - Hill AFB
Project No.: 2208-0652
MSAI Group: 3474

Dear Mr. Glascot:

Enclosed are the analytical results for your project referenced above. The following samples are included in the report.

870 MW-20	870 MW-1	Trip Blank

All holding times were met for the tests performed on these samples.

If the report is acceptable, please approve the enclosed invoice and forward it for payment.

Thank you for selecting Mountain States Analytical, Inc. to serve as your analytical laboratory on this project. If you have any questions concerning these results, please feel free to contact me at any time.

We look forward to working with you on future projects.

With Regards,

Leon A. Peterson
Project Manager

Analytical Report

Mountain States Analytical
The Quality Solution

MSAI Sample:	14774
MSAI Group:	3474
Date Reported:	01/06/94
Discard Date:	02/05/94
Date Submitted:	12/21/93
Date Sampled:	12/21/93
Collected by:	MA
Purchase Order:	
Project No.:	2208-0652

Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Attn: Mr. Robert Glascot
Project: 870 - Hill AFB

Sample ID: 870 MW-20
Matrix: Waste Water

Test	Analysis	Results as Received	Units		Limit of Quantitation
7254	Iron by ICP	11.4	mg/l		0.10
	Method: SW-846 6010				
0219	Nitrogen, Nitrate/Nitrite	< 0.05	mg/l		0.05
	Method: EPA 353.3				
1125	Sulfate, Turbidimetric	3	mg/l		2
	Method: EPA 375.4				
0976	Drinking water volatiles				
	Method: EPA 524.2				
	1,2,4-Trimethylbenzene (Pseudocumen	< 10	ug/l	(1)	10
	1,3,5-Trimethylbenzene	100	ug/l		10

(1) Due to high target compound level(s), dilution was required. The LOQ was raised accordingly.

Respectfully Submitted,
Reviewed and Approved by:

Leon A. Peterson
Project Manager

Analytical Report

Mountain States Analytical
The Quality Solution

MSAI Sample:	14775
MSAI Group:	3474
Date Reported:	01/06/94
Discard Date:	02/05/94
Date Submitted:	12/21/93
Date Sampled:	12/21/93
Collected by:	MA
Purchase Order:	
Project No.:	2208-0652

Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Attn: Mr. Robert Glascot
Project: 870 - Hill AFB

Sample ID: 870 MW-1
Matrix: Waste Water

Test	Analysis	Results as Received	Units	Limit of Quantitation
7254	Iron by ICP	10.8	mg/l	0.10
	Method: SW-846 6010			
0219	Nitrogen, Nitrate/Nitrite	< 0.05	mg/l	0.05
	Method: EPA 353.3			
1125	Sulfate, Turbidimetric	2	mg/l	2
	Method: EPA 375.4			
0976	Drinking water volatiles			
	Method: EPA 524.2			
	1,2,4-Trimethylbenzene (Pseudocumen	680	ug/l	(1) 10
	1,3,5-Trimethylbenzene	330	ug/l	10

(1) Due to high target compound level(s), dilution was required. The LOQ was raised accordingly.

Respectfully Submitted,
Reviewed and Approved by:

Leon A. Peterson
Project Manager

1645 West 2200 South. Salt Lake City, Utah 84119 (801) 973-0050 FAX (801) 972-6278

Analytical Report

Mountain States Analytical
The Quality Solution

MSAI Sample:	14776
MSAI Group:	3474
Date Reported:	01/06/94
Discard Date:	02/05/94
Date Submitted:	12/21/93
Date Sampled:	12/21/93
Collected by:	MA
Purchase Order:	
Project No.:	2208-0652

Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Attn: Mr. Robert Glascot
Project: 870 - Hill AFB

Sample ID: Trip Blank
Matrix: Waste Water

Test	Analysis	Results as Received	Units	Limit of Quantitation
0976	Drinking water volatiles			
	Method: EPA 524.2			
	1,2,4-Trimethylbenzene (Pseudocumen	< 0.5	ug/l	0.5
	1,3,5-Trimethylbenzene	< 0.5	ug/l	0.5

Respectfully Submitted,
Reviewed and Approved by:

Leon A. Peterson
Project Manager

1645 West 2200 South, Salt Lake City, Utah 84119 (801) 973-0050 FAX (801) 972-6278

Chain of Custody Number 3
Cooler Number —
Lot Control ID —
Page 1 of 1
Air Bill No.

HILL AIR FORCE BASE
OPERABLE UNIT 1
CHAIN OF CUSTODY RECORD/LAB WORK REQUEST

LABORATORY Mountain States

MONTGOMERY WATSON, INC.
Phone (801) 272-1900 FAX (801) 272-0430
MW Contact Bob Mascot
Project 870 - Hill AFB
Project Number 2208.0652
Date Due
Samplers Signature Mark Augustey

Lab ID No. (Lab Only)	Location ID	Sample ID	Depth Interval (ft)	Date Collected	Time Collected	Matrix[1]	Sampling Technique[2]	Number of Containers (Total)	VOC (SW 8240) (SW 8260) 524.2	BNAE (SW 8270 + SIM) (SW 8270)	Hex Chrome (SW 7196)	Cl, Fl, SO_4, Nitrate, CO_3/HCO_3, TDS	Ca, Fe, Mg, Mn, K, Na	As, Ca, Fe, Mg, Mn, K, Na	As, Cr, Ca, Fe, Mg, Mn, K, Na	Total Fe	NO3/NO2/SO4				
	870	MW-20	8	12-21	0900	GW	B	5	X							X	X				
	870	MW-1	8	12-21	1140	GW	B	5	X							X	X				
		TB 12-21-93		12-21	NA	NA	NA	2	X												

12-21-93 MA

[1] Matrix:
SO - Soil
SE - Sediment
WS - Surface Water
WG - Ground Water
LF - Product
AA - Air
SW - Wipe
DC - Drum Solids
LD - Drum Liquids
EP/TCLP Leachate

[2] Sampling Technique:
Composite=C
Grab=G

SPECIAL INSTRUCTIONS (i.e. metals list...):

Relinquished by	Received by	Date	Time	Relinquished by	Received by	Date	Time
MA	Pamela Olsen	12-21-93	1434				

LABORATORY USE ONLY

SAMPLES WERE:
1 Shipped or hand delivered
Notes:
2 Ambient or Chilled
Notes:
3 Temperature ______
4 Received Broken/Leaking (Improperly Sealed)
Y N
Notes
5 Properly Preserved
Y N
Notes:
6 Received Within Holding Times
Y N
Notes:

COC Tape Was:
1 Present on Outer Package
Y N NA
2 Unbroken on Outer Package
Y N NA
3 Present on Sample
Y N NA
4 Unbroken on Sample
Y N NA
Notes:

Discrepancies Between Sample Labels and COC Record?
Y N
Notes

Invoice No. 202434
Invoice Date 01/06/94
Page of

Mountain States Analytical
The Quality Solution

Mr. Robert Glascot
Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Salt Lake City, UT 84124
Suite 200

Project Name: 870 - Hill AFB
Project Number: 2208-0652
Purchase Order:
Samples Received: 12/21/93
Date Reported: 01/06/94
Turnaround Time: 16 days
Reported To: Mr. Robert Glascot

Analyses Performed
See Analysis Reference Table Below

MSAI Group Number: 3474

Sample I.D.	Date Sampled	Analyses	List Price	Rush Charges	Discount	Extended Price
14774 870 MW-20	12/21/93	0001F 0219 03921 0976 1125 7254	444.00		66.60	377.40
14775 870 MW-1	12/21/93	0001F 0219 03921 0976 1125 7254	444.00		66.60	377.40
14776 Trip Blank	12/21/93	0001F 0976	375.00		56.25	318.75

Total Price $ 1,073.55

Analysis Reference Table

Analysis No.	Analysis Name	Matrix	Method	# of Tests	Unit List Price	Unit Rush Charges	Unit Discount Amount	Unit Net Price	Extended
0001F	Special Instructions, GC/MS VOA		SPECIAL INST. MSAI	3	0.00		0.00	0.00	0.0
0219	Nitrogen, Nitrate/Nitrite	WA	EPA 353.3	2	15.00		2.25	12.75	25.5
03921	Flame/ICP Prep for Metals, Waters	WW	SW-846 3005	2	15.00		2.25	12.75	25.5
0976	Drinking water volatiles	WA	EPA 524.2	3	375.00		56.25	318.75	956.2
1125	Sulfate, Turbidimetric	WW	EPA 375.4	2	25.00		3.75	21.25	42.5
7254	Iron by ICP	WW	SW-846 6010	2	14.00		2.10	11.90	23.8

Total Price $ 1,073.5

Pricing Summary

Extended List Price	$ 1,263.
Total Rush Charges	$ 0.
Total Discount	$(189.
TOTAL AMOUNT DUE	$ 1,073.

Mountain States Analytical

January 6, 1994

Mr. Robert Glascot
Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Reference:
Project: Hill AFB - 870
Project No.: 2208-0652
MSAI Group: 3465

Dear Mr. Glascot:

Enclosed are the analytical results for your project referenced above. The following samples are included in the report.

870 MW-8	870 MW-4	870 MW-2
Trip Blank		

All holding times were met for the tests performed on these samples.

If the report is acceptable, please approve the enclosed invoice and forward it for payment.

Thank you for selecting Mountain States Analytical, Inc. to serve as your analytical laboratory on this project. If you have any questions concerning these results, please feel free to contact me at any time.

We look forward to working with you on future projects.

With Regards,

Leon A. Peterson
Project Manager

Analytical Report

Mountain States Analytical
The Quality Solution

MSAI Sample:	14748
MSAI Group:	3465
Date Reported:	01/06/94
Discard Date:	02/05/94
Date Submitted:	12/21/93
Date Sampled:	12/20/93
Collected by:	WA
Purchase Order:	
Project No.:	2208-0652

Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Attn: Mr. Robert Glascot
Project: Hill AFB - 870

Sample ID: 870 MW-8
Matrix: Waste Water

Test	Analysis	Results as Received	Units		Limit of Quantitation
7254	Iron by ICP Method: SW-846 6010	5.22	mg/l		0.10
0219	Nitrogen, Nitrate/Nitrite Method: EPA 353.3	0.28	mg/l		0.05
1125	Sulfate, Turbidimetric Method: EPA 375.4	11	mg/l		2
0976	Drinking water volatiles Method: EPA 524.2				
	1,2,4-Trimethylbenzene (Pseudocumen	280	ug/l	(1)	10
	1,3,5-Trimethylbenzene	140	ug/l		10

(1) Due to high target compound level(s), dilution was required. The LOQ was raised accordingly.

Respectfully Submitted,
Reviewed and Approved by:

Leon A. Peterson
Project Manager

Analytical Report

Mountain States Analytical
The Quality Solution

Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Attn: Mr. Robert Glascot
Project: Hill AFB - 870

Sample ID: 870 MW-4
Matrix: Waste Water

MSAI Sample: 14749
MSAI Group: 3465
Date Reported: 01/06/94

Discard Date: 02/05/94
Date Submitted: 12/21/93
Date Sampled: 12/20/93
Collected by: WA
Purchase Order:
Project No.: 2208-0652

Test	Analysis	Results as Received	Units	Limit of Quantitation
7254	Iron by ICP	13.6	mg/l	0.10
	Method: SW-846 6010			
0219	Nitrogen, Nitrate/Nitrite	2.32	mg/l	0.05
	Method: EPA 353.3			
1125	Sulfate, Turbidimetric	< 2	mg/l	2
	Method: EPA 375.4			
0976	Drinking water volatiles			
	Method: EPA 524.2			
	1,2,4-Trimethylbenzene (Pseudocumen	1,500	ug/l	(1) 100
	1,3,5-Trimethylbenzene	550	ug/l	100

(1) Due to high target compound level(s), dilution was required. The LOQ was raised accordingly.

Respectfully Submitted,
Reviewed and Approved by:

Leon A. Peterson
Project Manager

Analytical Report

Mountain States Analytical
The Quality Solution

MSAI Sample:	14750
MSAI Group:	3465
Date Reported:	01/06/94

Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Discard Date:	02/05/94
Date Submitted:	12/21/93
Date Sampled:	12/20/93
Collected by:	WA
Purchase Order:	
Project No.:	2208-0652

Attn: Mr. Robert Glascot
Project: Hill AFB - 870

Sample ID: 870 MW-2
Matrix: Waste Water

Test	Analysis	Results as Received	Units		Limit of Quantitation
7254	Iron by ICP Method: SW-846 6010	50.5	mg/l		0.10
0219	Nitrogen, Nitrate/Nitrite Method: EPA 353.3	0.25	mg/l		0.05
1125	Sulfate, Turbidimetric Method: EPA 375.4	40	mg/l		2
0976	Drinking water volatiles Method: EPA 524.2				
	1,2,4-Trimethylbenzene (Pseudocumen	750	ug/l	(1)	20
	1,3,5-Trimethylbenzene	350	ug/l		20

(1) Due to high target compound level(s), dilution was required. The LOQ was raised accordingly.

Respectfully Submitted,
Reviewed and Approved by:

Leon A. Peterson
Project Manager

1645 West 2200 South, Salt Lake City, Utah 84119 (801) 973-0050 FAX (801) 972-6278

Analytical Report

Mountain States Analytical
The Quality Solution

Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Attn: Mr. Robert Glascot
Project: Hill AFB - 870

Sample ID: Trip Blank
Matrix: Waste Water

MSAI Sample: 14751
MSAI Group: 3465
Date Reported: 01/06/94

Discard Date: 02/05/94
Date Submitted: 12/21/93
Date Sampled: 12/20/93
Collected by: WA
Purchase Order:
Project No.: 2208-0652

Test	Analysis	Results as Received	Units	Limit of Quantitation
0976	Drinking water volatiles			
	Method: EPA 524.2			
	1,2,4-Trimethylbenzene (Pseudocumen	< 0.5	ug/l	0.5
	1,3,5-Trimethylbenzene	< 0.5	ug/l	0.5

Respectfully Submitted,
Reviewed and Approved by:

Leon A. Peterson
Project Manager

1645 West 2200 South, Salt Lake City, Utah 84119 (801) 973-0050 FAX (801) 972-6278

HILL AIR FORCE BASE
OPERABLE UNIT 1
CHAIN OF CUSTODY RECORD/LAB WORK REQUEST

Chain of Custody Number: 2
Cooler Number: —
Lot Control ID: —
Page 1 of 1
Air Bill No.: —

LABORATORY: Mountain States

MONTGOMERY WATSON, INC.
Phone (801) 272-1900 FAX (801) 272-9430
MW Contact: Bob Hancock
Project: 2208-0652
Project Number: Hill AFB 870
Date Due:
Samplers Signature: Mark Augustyn

Lab ID No. (Lab Only)	Location ID	Sample ID	Depth Interval (ft)	Date Collected	Time Collected	Matrix[1]	Sampling Technique[2]	Number of Containers (Total)	VOC (SW 8260) 524.2	BNAE (SW 8270 + SIM) (SW 8270)	Hex Chrome (SW 7196)	Cl, Fl, SO_4, Nitrate, CO_3/HCO_3, TDS	Ca, Fe, Mg, Mn, K, Na	As, Ca, Fe, Mg, Mn, K, Na	As, Cr, Ca, Fe, Mg, Mn, K, Na	Total Fe	NO3/NO2/SO4-2				
	870	MW-8	0	12-20	1433	W	G	5	X							X	X				
	870	MW-4	0	12-20	1455	W	G	5	X							X	X				
	870	MW-2	0	12-20	1517	W	G	5	X							X	X				
		TB 12-20-93		0900	—	—	—	2	X												

12-20-93
Mark Augustyn

SPECIAL INSTRUCTIONS (i.e. metals list...):

[1] Matrix:
SO- Soil
SE - Sediment
WS - Surface Water
WG - Ground Water
LF - Product
AA - Air
SW - Wipe
DC - Drum Solids
LD - Drum Liquids
EP/TCLP Leachate

[2] Sampling Technique:
Composite=C
Grab=G

Relinquished by	Received by	Date	Time	Relinquished by	Received by	Date	Time
MA	Ken Hale	12-20-93	1718				

LABORATORY USE ONLY

SAMPLES WERE:
1 Shipped or hand delivered
Notes:
2 Ambient or Chilled
Notes:
3 Temperature 2°C
4 Received Broken/Leaking (Improperly Sealed)
Y N
Notes
5 Properly Preserved
Y N
Notes
6 Received Within Holding Times
Y N
Notes

COC Tape Was:
1 Present on Outer Package
Y N NA
2 Unbroken on Outer Package
Y N NA
3 Present on Sample
Y N NA
4 Unbroken on Sample
Y N NA
Notes:

Discrepancies Between Sample Labels and COC Record?
Y N
Notes

Invoice No. 202433
Invoice Date 01/06/94
Page: 1 c

Mountain States Analytical
The Quality Solution

Mr. Robert Glascot
Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Salt Lake City, UT 84124
Suite 200

Project Name: Hill AFB - 870
Project Number: 2208-0652
Purchase Order:
Samples Received: 12/21/93
Date Reported: 01/06/94
Turnaround Time: 16 days
Reported To: Mr. Robert Glascot

Analyses Performed

MSAI Group Number: 3465

See Analysis Reference Table Below

Sample I.D.	Date Sampled	Analyses	List Price	Rush Charges	Discount	Extenc Price
14748 870 MW-8	12/20/93	0001F 0219 03921 0976 1125 7254	444.00		66.60	377.
14749 870 MW-4	12/20/93	0001F 0219 03921 0976 1125 7254	444.00		66.60	377.
14750 870 MW-2	12/20/93	0001F 0219 03921 0976 1125 7254	444.00		66.60	377.
14751 Trip Blank	12/20/93	0001F 0976	375.00		56.25	318.

Total Price $ 1,45C.

Analysis Reference Table

Analysis No.	Analysis Name	Matrix	Method	# of Tests	Unit List Price	Unit Rush Charges	Unit Discount Amount	Unit Net Price	Extence Price
0001F	Special Instructions, GC/MS VOA		SPECIAL INST. MSAI	4	0.00		0.00	0.00	C.
0219	Nitrogen, Nitrate/Nitrite	WA	EPA 353.3	3	15.00		2.25	12.75	38.
03921	Flame/ICP Prep for Metals, Waters	WW	SW-846 3005	3	15.00		2.25	12.75	38.
0976	Drinking water volatiles	WA	EPA 524.2	4	375.00		56.25	318.75	1,275.
1125	Sulfate, Turbidimetric	WW	EPA 375.4	3	25.00		3.75	21.25	63.
7254	Iron by ICP	WW	SW-846 6010	3	14.00		2.10	11.90	35.

Total Price $ 1,45C.

Pricing Summary

Extended List Price	$ 1,707.
Total Rush Charges	$ C.
Total Discount	$(25[illegible]
TOTAL AMOUNT DUE	$ 1,45C.

Mountain States Analytical

January 5, 1994

Mr. Robert Glascot
Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Reference:
Project: UST 870
MSAI Group: 3452

Dear Mr. Glascot:

Enclosed are the analytical results for y project referenced above. The following samples are included in the report.

870 MW-5 870 MW-3 870 MW-6
Trip Blank

All holding times were met for the tests performed on these samples except:

Sample - (Sample Date) Test Description	Expiration Date	Date Analyzed	Days Past Holding Time
870 MW-5 - (12/17/93)			
Nitrogen, Nitrate/Nitrite	12/19/93	12/20/93	1
870 MW-3 - (12/17/93)			
Nitrogen, Nitrate/Nitrite	12/19/93	12/20/93	1
870 MW-6 - (12/17/93)			
Nitrogen, Nitrate/Nitrite	12/19/93	12/20/93	1

If the report is acceptable, please approve the enclosed invoice

and forward it for payment.

Thank you for selecting Mountain States Analytical, Inc. to serve as your analytical laboratory on this project. If you have any questions concerning these results, please feel free to contact me at any time.

We look forward to working with you on future projects.

With Regards,

Leon A. Peterson
Project Manager

Analytical Report

Mountain States Analytical
The Quality Solution

Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Attn: Mr. Robert Glascot
Project: UST 870

Sample ID: 870 MW-5
Matrix: Waste Water

MSAI Sample: 14700
MSAI Group: 3452
Date Reported: 01/05/94

Discard Date: 02/04/94
Date Submitted: 12/20/93
Date Sampled: 12/17/93
Collected by: BG
Purchase Order:
Project No.:

Test	Analysis	Results as Received	Units	Limit of Quantitation
7254	Iron by ICP Method: SW-846 6010	6.41	mg/l	0.10
0219	Nitrogen, Nitrate/Nitrite Method: EPA 353.3	ND	mg/l	0.05
1125	Sulfate, Turbidimetric Method: EPA 375.4	ND	mg/l	2
0976	Drinking water volatiles Method: EPA 524.2			
	1,2,4-Trimethylbenzene (Pseudocumen	960	ug/l	25
	1,3,5-Trimethylbenzene	450	ug/l	25

ND - Not detected at the limit of detection

Respectfully Submitted,
Reviewed and Approved by:

Leon A. Peterson
Project Manager

1645 West 2200 South, Salt Lake City, Utah 84119 (801) 973-0050 FAX (801) 972-6278

Analytical Report

Mountain States Analytical
The Quality Solution

Montgomery Watson, Inc.	MSAI Sample: 14701
4525 South Wasatch Blvd.	MSAI Group: 3452
Suite 200	Date Reported: 01/05/94
Salt Lake City, UT 84124	Discard Date: 02/04/94
	Date Submitted: 12/20/93
Attn: Mr. Robert Glascot	Date Sampled: 12/17/93
Project: UST 870	Collected by: BG
	Purchase Order:
Sample ID: 870 MW-3	Project No.:
Matrix: Waste Water	

Test	Analysis	Results as Received	Units	Limit of Quantitation
7254	Iron by ICP Method: SW-846 6010	8.20	mg/l	0.10
0219	Nitrogen, Nitrate/Nitrite Method: EPA 353.3	ND	mg/l	0.05
1125	Sulfate, Turbidimetric Method: EPA 375.4	ND	mg/l	2
0976	Drinking water volatiles Method: EPA 524.2			
	1,2,4-Trimethylbenzene (Pseudocumen	1,000	ug/l	25
	1,3,5-Trimethylbenzene	480	ug/l	25

ND - Not detected at the limit of detection

Respectfully Submitted,
Reviewed and Approved by:

Leon A. Peterson
Project Manager

1645 West 2200 South, Salt Lake City, Utah 84119 (801) 973-0050 FAX (801) 972-6278

Analytical Report

Mountain States Analytical
The Quality Solution

Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Attn: Mr. Robert Glascot
Project: UST 870

Sample ID: 870 MW-6
Matrix: Waste Water

MSAI Sample: 14702
MSAI Group: 3452
Date Reported: 01/05/94

Discard Date: 02/04/94
Date Submitted: 12/20/93
Date Sampled: 12/17/93
Collected by: BG
Purchase Order:
Project No.:

Test	Analysis	Results as Received	Units	Limit of Quantitation
7254	Iron by ICP Method: SW-846 6010	10.3	mg/l	0.10
0219	Nitrogen, Nitrate/Nitrite Method: EPA 353.3	0.07	mg/l	0.05
1125	Sulfate, Turbidimetric Method: EPA 375.4	21	mg/l	2
0976	Drinking water volatiles Method: EPA 524.2			
	1,2,4-Trimethylbenzene (Pseudocumen	1,500	ug/l	120
	1,3,5-Trimethylbenzene	650	ug/l	120

Respectfully Submitted,
Reviewed and Approved by:

Leon A. Peterson
Project Manager

1645 West 2200 South, Salt Lake City, Utah 84119 (801) 973-0050 FAX (801) 972-6278

Analytical Report

Mountain States Analytical
The Quality Solution

Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Suite 200
Salt Lake City, UT 84124

Attn: Mr. Robert Glascot
Project: UST 870

Sample ID: Trip Blank
Matrix: Waste Water

MSAI Sample: 14703
MSAI Group: 3452
Date Reported: 01/05/94

Discard Date: 02/04/94
Date Submitted: 12/20/93
Date Sampled: 12/17/93
Collected by: BG
Purchase Order:
Project No.:

Test	Analysis	Results as Received	Units	Limit of Quantitation
)976	Drinking water volatiles			
	Method: EPA 524.2			
	1,2,4-Trimethylbenzene (Pseudocumen	< 0.5	ug/l	0.5
	1,3,5-Trimethylbenzene	< 0.5	ug/l	0.5

Respectfully Submitted,
Reviewed and Approved by:

Leon A. Peterson
Project Manager

1645 West 2200 South, Salt Lake City, Utah 84119 (801) 973-0050 FAX (801) 972-6278

CHAIN OF CUSTODY RECORD/LAB WC.IK REQUEST

Chain of Custody Number 2
Cooler Number NA
Lot Control ID AA
Page 1 of 1
Air Bill No. 3

LABORATORY Mountain States

MONTGOMERY WATSON, INC.
Phone (801) 272-1900 FAX (801) 272-0430
MW Contact Bit Flasset
Project UST 870
Project Number
Date Due
Samplers Signature Mark Augusty

Lab ID No. (Lab Only)	Location ID	Sample ID	Depth Interval (ft)	Date Collected	Time Collected	Matrix[1]	Sampling Technique[2]	Number of Containers (Total)	~~VOC~~ 524.2 THM	BNAE	Pest/PCB	Dioxin/Furan	TPH MOD	~~Metals~~ IRON	Cyanide	TCLP-Metals VOC BNAE Pest.	NO3/NO2/SO4				
	870	MW-5	0	12-17	1325	GW	G	5	X					X			X				
	870	MW-3	0	12-17	1257	GW	G	5	X					X			X				
	870	MW-6	0	12-17	1515	GW	G	5	X					X			X				
	T.B	12-17-93		12-17	0730	AA	AA	2	X												

[1] Matrix:
SO - Soil
SE - Sediment
WS - Surface Water
WG - Ground Water
LF - Product
AA - Air
SW - Wipe
DC - Drum Solids
LD - Drum Liquids
EP/TCLP Leachate

[2] Sampling Technique:
Composite=C
Grab=G

SPECIAL INSTRUCTIONS (i.e. metals list...):

Relinquished by	Received by	Date	Time	Relinquished by	Received by	Date	Time
[signature]	[signature]	12-17-93	1720				

LABORATORY USE ONLY

SAMPLES WERE:

1 Shipped or hand delivered
Notes:
2 Ambient or Chilled
Notes:
3 Temperature ~4C
4 Received Broken/Leaking (Improperly Sealed)
Y N
Notes
5 Properly Preserved
Y N
Notes:
6 Received Within Holding Times
Y N
Notes

COC Tape Was:

1 Present on Outer Package
Y N NA
2 Unbroken on Outer Package
Y N NA
3 Present on Sample
Y N NA
4 Unbroken on Sample
Y N NA
Notes:

Discrepancies Between Sample Labels and COC Record?
Y N
Notes:

Invoice

Invoice No.	202406
Invoice Date	01/0[illegible]
Page:	1

Mountain States Analytical

The Quality Solution

Mr. Robert Glascot
Montgomery Watson, Inc.
4525 South Wasatch Blvd.
Salt Lake City, UT 84124
Suite 200

Project Name:	UST 870
Project Number:	
Purchase Order:	
Samples Received:	12/20/93
Date Reported:	01/05/94
Turnaround Time:	16 days
Reported To:	Mr. Robert Glascot

Analyses Performed

MSAI Group Number: 3452

See Analysis Reference Table Below

Sample I.D.	Date Sampled	Analyses	List Price	Rush Charges	Discount	Extended Price
14700 870 MW-5	12/17/93	0001F 0219 03921 0976 1125 7254	444.00		66.60	377.40
14701 870 MW-3	12/17/93	0001F 0219 03921 0976 1125 7254	444.00		66.60	377.40
14702 870 MW-6	12/17/93	0001F 0219 03921 0976 1125 7254	444.00		66.60	377.40
14703 Trip Blank	12/17/93	0001F 0976	375.00		56.25	318.75

Total Price $ 1,450.95

Analysis Reference Table

Analysis No.	Analysis Name	Matrix	Method	# of Tests	Unit List Price	Unit Rush Charges	Unit Discount Amount	Unit Net Price	Extended Price
0001F	Special Instructions, GC/MS VOA		SPECIAL INST. MSAI	4	0.00		0.00	0.00	0.00
0219	Nitrogen, Nitrate/Nitrite	WA	EPA 353.3	3	15.00		2.25	12.75	38.25
03921	Flame/ICP Prep for Metals, Waters	WW	SW-846 3005	3	15.00		2.25	12.75	38.25
0976	Drinking water volatiles	WA	EPA 524.2	4	375.00		56.25	318.75	1,275.00
1125	Sulfate, Turbidimetric	WW	EPA 375.4	3	25.00		3.75	21.25	63.75
7254	Iron by ICP	WW	SW-846 6010	3	14.00		2.10	11.90	35.7[illegible]

Total Price $ 1,450.9[illegible]

Pricing Summary

Extended List Price	$ 1,707.0
Total Rush Charges	$ 0.0
Total Discount	$(256.0
TOTAL AMOUNT DUE	$ 1,450.9

MANTECH

Ref: 94-BN3/rc

January 6, 1994

Dr. John Wilson
R.S. Kerr Environmental Research Lab
U.S. Environmental Protection Agency
Post Office Box 1198
Ada, OK 74820

THRU: S.A. Vandegrift SAV

Dear John:

Attached are results for methane on samples as per Service Request # RE-0-39. Samples were received on 12/22/93 and 12/28/93 and analyzed on 12/27/93 and 1/3/94. Samples were prepared as described in the paper "Dissolved Oxygen and Methane in Water by a GC Headspace Equilibration Technique", by Kampbell et al., in International Journal of Environmental Analytical Chemistry, Volume 36, pp. 249-257. Analysis and calculations were performed as per RSKSOP-147.

If you have any questions, please feel free to see me.

Sincerely,

Bryan Newell

Bryan Newell

xc: R.L. Cosby
J.L. Seeley

ManTech Environmental Technology, Inc.
P.O. Box 12313, 2 Triangle Drive, Research Triangle Park, North Carolina 27709 919-549-0611 FAX 919-549-4665

SF-0-39

ANALYZED 12/27/93

SAMPLE	METHANE
LAB BLANK	0.0003
MW-2	0.0003
MW-3	0.459
MW-4	0.012
MW-5	2.040
MW-6	0.002
MW-7	ND
MW-8	0.006
MW-9	0.006
MW-13	0.498
MW-13 FIELD DUP	0.483
MW-14	0.023
MW-14 LAB DUP	0.023
ANALYZED 1/3/94	
MW-1	0.041
MW-1 FIELD DUP	0.042
MW-20	0.044
STANDARDS	
10 PPM CH4	9.86
100 PPM CH4	99.79
1000 PPM CH4	1000.05
1 % CH4	0.94
4 % CH4	3.79
LIMITS OF QUANTITATION	
LOWER	0.001
UPPER	3.679

UNITS FOR SAMPLES ARE mg/L
UNITS FOR STANDARDS CORRESPOND
TO UNITS IN THE SAMPLE COLUMN.

CHAIN OF CUSTODY RECORD/LAB WORK REQUEST

Chain of Custody Number 1
Cooler Number —
Lot Control ID —
Page 1 of 1
Air Bill No.

LABORATORY U.S. EPA

MONTGOMERY WATSON, INC.
Phone (801) 272-1900 FAX (801) 272-0430
MW Contact Bob Glascot
Project Hill AFB - 870
Project Number 2208-
Date Due
Samplers Signature [illegible]

Lab ID No. (Lab Only)	Location ID	Sample ID	Depth Interval (ft)	Date Collected	Time Collected	Matrix[1]	Sampling Technique[2]	Number of Containers (Total)	VOC	SNAE	Pest/PCB	Dioxin/Furan	TPH MOD	Metals	Cyanide	TCLP-Metals VOC SNAE Pest.	METHANE				
	870	MW-7	0	12-16	1105	GW	G	2									X				
	"	MW-9	0	12-16	1645	GW	G	2									X				
	"	MW-14	0	12-16	1520	GW	G	2									X				
	"	MW-13	0	12-16	1240	GW	G	2									X				
	"	MW-5	0	12-17	1325	GW	G	2									X				
	"	MW-3	0	12-17	1257	GW	G	2									X				
	"	MW-6	0	12-17	1515	GW	G	2									X				
	"	MW-8	0	12-20	1433	GW	G	2									X				
	"	MW-4	0	12-20	1455	GW	G	2									X				
	"	MW-2	0	12-20	1517	GW	G	2									X				

[1] Matrix:
SO- Soil
SE - Sediment
WS - Surface Water
WG - Ground Water
LF - Product
AA - Air
SW - Wipe
DC - Drum Solids
LD- Drum Liquids
EP/TCLP Leachate

[2] Sampling Technique:
Composite=C
Grab=G

SPECIAL INSTRUCTIONS (i.e. metals list...):

Relinquished by	Received by	Date	Time	Relinquished by	Received by	Date	Time
[illegible]	FED-X	12-20-93	1700				
[illegible]	[illegible]	12-21-93	1300				
	[illegible]	12-27-93	0700				

LABORATORY USE ONLY

SAMPLES WERE:

1 Shipped or hand delivered
Notes:

2 Ambient or Chilled
Notes:

3 Temperature ______

4 Received Broken/Leaking (Improperly Sealed)
Y N
Notes:

5 Properly Preserved
Y N
Notes:

6 Received Within Holding Times
Y N
Notes:

COC Tape Was:

1 Present on Outer Package
Y N NA

2 Unbroken on Outer Package
Y N NA

3 Present on Sample
Y N NA

4 Unbroken on Sample
Y N NA
Notes:

Discrepancies Between Sample Labels and COC Record?
Y N
Notes:

HILL AIR FORCE BASE
OPERABLE UNIT 1
CHAIN OF CUSTODY RECORD/LAB WORK REQUEST

LABORATORY EPA

Chain of Custody Number 2
Cooler Number —
Lot Control ID —
Page 1 of 1
Air Bill No.

MONTGOMERY WATSON, INC.
Phone (801) 272-1900 FAX (801) 272-8430
MW Contact Bob Elacot
Project 870 - Hill AFB
Project Number 2208.0652
Date Due
Samplers Signature Mark Augusty

Lab ID No. (Lab Only)	Location ID	Sample ID	Depth Interval (ft)	Date Collected	Time Collected	Matrix[1]	Sampling Technique[2]	Number of Containers (Total)	VOC (SW 8240) (SW 8260)	BNAE (SW 8270 + SIM) (SW 8270)	Hex Chrome (SW 7196)	Cl, Fl, SO_4, Nitrate, CO_3/HCO_3, TDS	Ca, Fe, Mg, Mn, K, Na	As, Ca, Fe, Mg, Mn, K, Na	As, Cr, Ca, Fe, Mg, Mn, K, Na	METHANE					
	870	MW-1	0	12/21	1140	W	G	2								X					
	870	MW-20	0	12/21	0903	W	G	2								X					

12-21-93

SPECIAL INSTRUCTIONS (i.e. metals list...):

[1] Matrix:
SO - Soil
SE - Sediment
WS - Surface Water
WG - Ground Water
LF - Product
AA - Air
SW - Wipe
DC - Drum Solids
LD - Drum Liquids
EP/TCLP Leachate

[2] Sampling Technique:
Composite=C
Grab=G

Relinquished by	Received by	Date	Time	Relinquished by	Received by	Date	Time
[illegible]	FED-X	12-21-93	1700				
	Stacy Vandyk [illegible]	12/28/93	1500				
SV	Bryan Newell	12-28-93	1530				

PROJECT NO. 2208.0712

LABORATORY USE ONLY

SAMPLES WERE:
1 Shipped or hand delivered
Notes:
2 Ambient or Chilled
Notes:
3 Temperature
4 Received Broken/Leaking (Improperly Sealed)
Y N
Notes:
5 Properly Preserved
Y N
Notes:
6 Received Within Holding Times
Y N
Notes:

COC Tape Was:
1 Present on Outer Package
Y N NA
2 Unbroken on Outer Package
Y N NA
3 Present on Sample
Y N NA
4 Unbroken on Sample
Y N NA
Notes:

Discrepancies Between Sample Labels and COC Record?
Y N
Notes:

MANAGEMENT
TECHNOLOGY

Ref: 93-LS9
August 25, 1993

Dr. Don Kampbell
R.S. Kerr Environmental Research Lab
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74821-1198

THRU: S.A. Vandegrift SAV

Dear Don:

Please find attached results of the aqueous samples from Hill AFB, in Utah, to be analyzed by purge-and-trap GC-PID/FID for Benzene, Toluene, Ethylbenzene, the Xylene isomers, the Trimethylbenzenes and Fuel Carbon. We received your 11 samples, in duplicate, on August 24, 1993 in 40 mL VOA vials. A 1/10 dilution was performed on sample "82-MW-11" due to the presence of free-floating product on the sample. On August 24, 1993, automated purge-and-trap sampling was performed using an OI autosampler and an OI 4460 sample concentrator in line with a HP 5890 gas chromatograph. A 5 place external standard curve (1-10-100-500-1000 ppb) was used to uantitate the samples.

This work was performed under Service Request #SF-0-5. RSKSOP-133, "Simultaneous Analysis of Aromatics and Total Fuel Carbon by Dual Column-Dual Detector for Ground Water Samples" was used for these analyses.

If you have any questions about these analyses, please contact me at your convenience.

Sincerely,

Lisa R. Secrest

Lisa R. Secrest

xc: R.L. Cosby
J.L. Seeley jls

ManTech Environmental Technology, Inc.
P.O. Box 1198, Ada, Oklahoma 74820 405-332-8800 FAX 405-332-8800 ext. 235

OI-P&T/GC-PID:FID HILL AFB SAMPLES FOR DR. KAMPBELL

UNITS = NG/ML ANALYST:L.SECREST

SAMPLE NAME	BENZENE	TOLUENE	ETHYLBENZENE	p-XYLENE	m-XYLENE	o-XYLENE	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB	FUEL CARBON
100 PPB	1.02E+02	1.01E+02	9.95E+01	9.78E+01	9.78E+01	9.69E+01	9.49E+01	9.49E+01	9.57E+01	N/A
QC, OBSERVED, PPB	5.17E+01	5.30E+01	5.18E+01	4.79E+01	4.84E+01	4.98E+01	4.57E+01	4.82E+01	4.67E+01	N/A
QC, TRUE VALUE, PPB	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	N/A
QC LAB BLANK, PPB	ND	ND	ND	ND	ND	ND	ND	ND	ND	N/A
O-2 SEWER	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
O-3 STORM	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
82 A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
82 B	ND	4.29E+00	ND	ND	ND	ND	1.06E+00	1.43E+00	ND	8.13E+00
82 C	4.92E+00	3.13E+00	2.65E+01	4.28E+01	4.72E+01	2.62E+00	2.38E+02	3.24E+02	1.20E+02	2.10E+03
82 D	9.58E+01	1.04E+01	1.47E+02	1.49E+02	3.83E+02	1.03E+02	1.29E+02	1.83E+02	8.88E+01	2.47E+03
82 E	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
82 F	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
500 PPB	4.73E+02	4.76E+02	4.79E+02	4.75E+02	4.79E+02	4.75E+02	4.79E+02	4.71E+02	4.68E+02	ND
82-H	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
82-MW-11	3.36E+02	9.03E+01	1.39E+02	2.30E+02	6.35E+02	2.04E+02	7.18E+01	1.65E+02	6.93E+01	2.08E+03
*82-MW-10	ND	2.90E+02	4.43E+02	4.01E+02	2.47E+03	1.28E+03	5.75E+02	8.28E+02	6.07E+02	1.80E+04
QC LAB BLANK, PPB	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2.5 PPB	2.30E+00	2.09E+00	3.12E+00	2.69E+00	1.93E+00	2.43E+00	2.47E+00	2.25E+00	2.39E+00	N/A
QC, OBSERVED, PPB	5.24E+01	5.29E+01	5.27E+01	4.88E+01	4.89E+01	5.09E+01	4.74E+01	4.95E+01	4.82E+01	N/A
QC, TRUE VALUE, PPB	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	N/A

ND = None D- * Lower Limit of Quantitation = 10 ppb

MANTECH

Ref: 93-LS10
August 30, 1993

Dr. Don Kampbell
R.S. Kerr Environmental Research Lab
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74821-1198

THRU: S.A. Vandegrift SAV

Dear Don:

This letter is written in response to Dr. J. Wilson's inquiry concerning the reported value of benzene for the Hill AFB aqueous sample "82-MW-10" (Ref: #93-LS9). Due to the presence of free-floating product on the aqueous sample, a 1/10 dilution was performed prior to analysis on August 24, 1993. The report letter incorrectly identified the diluted sample as "82-MW-11." As a result of Dr. Wilson's inquiry, a 1/2 dilution was made on the duplicate of sample "82-MW-10" and was analyzed on August 30, 1993. The sample was stored at 4°C until diluted. Results of the analysis are attached. Due to the dilution, the lower limit of quantitation is 2 ppb for all compounds. A place external standard curve (1-10-100-500-1000 ppb) was used to quantitate the sample.

This work was performed under Service Request #SF-0-5. RSKSOP-133, "Simultaneous Analysis of Aromatics and Total Fuel Carbon by Dual Column-Dual Detector for Ground Water Samples" was used for these analyses.

If you have any questions about these analyses, please contact me at your convenience.

Sincerely,

Lisa R. Secrest

Lisa R. Secrest

xc: R.L. Cosby
J.L. Seeley jls
J. Wilson

PRINTED 30-. _ -J SR:SF-0-5 OI-P&T/GC-PID:FID HILL AFB ..PLES FOR DR. KAMPBELL UNITS = NG/ML AN. :L SECREST

SAMPLE NAME	BENZENE	TOLUENE	ETHYLBENZENE	p-XYLENE	m-XYLENE	o-XYLENE	1,3,5-TMB	1,2,4-TMB	1,2,3-TMB	FUEL CARBON
QC, OBSERVED, PPB	4.52E+01	4.56E+01	4.87E+01	4.45E+01	4.27E+01	4.67E+01	4.32E+01	4.62E+01	4.35E+01	N/A
QC, TRUE VALUE, PPB	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	5.00E+01	N/A
2 PPB	1.79E+00	1.77E+00	2.13E+00	2.27E+00	1.84E+00	1.99E+00	1.99E+00	1.88E+00	1.89E+00	N/A
*82-MW-10 Duplicate	ND	3.40E+02	5.43E+02	4.71E+02	2.88E+03	1.49E+03	7.13E+02	9.74E+02	6.83E+02	1.77E+04

ND = None Detected; * Lower Limit of Quantitation = 2 ppb; N/A = Not Analyzed

APPENDIX D

GRIDDED MODEL INPUT AND CALIBRATION RESULTS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0																			
2	0	661	663	664	668	668	668	668	668	668	666	663	661	660	658	655	654	653	652	0
3																				
4																				
5																				
6																				
7																				
8																				
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24																				
25																				
26																				
27																				
28																				
29	0	535	535	535	535	535	535	535	535	535	535	535	535	535	535	535	535	535	535	[illegible]
30																				

Legend: Each cell is 85x110 ft
Add 4,000 ft for ground water elevation above mean-sea-level (msl)

Boundary Ground Water Levels For Hill AFB Model

ENGINEERING-SCIENCE, INC.
Denver, Colorado

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	1500	1100	100	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	300	[illegible]	[illegible]	[illegible]	2300	1000	300	0	0	0	0	0	0	0	0
5	0	0	0	0	0	1000	2500	[illegible]	[illegible]	6000	4000	2600	500	0	0	0	0	0	0	0
6	0	0	0	0	[illegible]	800	5300	[illegible]	[illegible]	6500	5000	3000	1500	200	0	0	0	0	0	0
7	0	0	0	0	100	1500	[illegible]	[illegible]	[illegible]	6200	5000	3000	1000	500	0	0	0	0	0	0
8	0	0	0	0	100	1100	[illegible]	[illegible]	[illegible]	[illegible]	4000	1500	500	100	0	0	0	0	0	0
9	0	0	0	0	100	1100	[illegible]	6000	[illegible]	[illegible]	2000	400	50	0	0	0	0	0	0	0
10	0	0	0	0	100 2000	6500	7000	5500	5500	2500	100	0	0	0	0	0	0	0	0	0
11	0	0	0	0	250	2000	4000	6000	4500	1000	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	300	2000	5000	6000	3000	100	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	250	2000	4500	6000	4500	800	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	1000	2000	5000	6000	3000	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	500	1000	1000	200	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0																			
20																				
21																				
22																				
23																				
24																				
25																				
26																				
27																				
28																				
29																				
30																				

Legend: Each cell is 85x110 ft
Concentrations are shown as µg/L, input as mg/L

Total BTEX Concentrations For Hill AFB Model

ENGINEERING-SCIENCE, INC.
Denver, Colorado

	Oxygen concentrations used for initial setup of Hill model, Fall 1993																				
	(mg/L)																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	(x-axis)
(y-axis) 1	5	5	5	5	5	5	4.7	4.9	5	5	5	5	5	5	5	5	5	5	5	5	
2	5	5	5	5	5	4.8	3	3	4.5	5	5	5	5	5	5	5	5	5	5	5	
3	5	5	5	5	5	4.1	1	1	3	4.5	5	5	5	5	5	5	5	5	5	5	
4	5	5	5	5	4.8	3.1	3	1	2	3	4	4.7	5	5	5	5	5	5	5	5	
5	5	5	5	5	4.5	3	0.1	1.1	1.5	2	2.9	3.6	4.7	5	5	5	5	5	5	5	
6	5	5	5	4.9	4.2	2.5	0.5	0.1	0.3	1	2	3	4	4.7	5	5	5	5	5	5	
7	5	5	5	4.7	4	2	0.5	0	0.5	1.2	2	3	3.9	4.5	5	5	5	5	5	5	
8	5	5	5	4.5	3.2	1.7	0.5	0	1	1.5	2.2	2.9	3.6	4.2	4.9	5	5	5	5	5	
9	5	5	4.7	4.2	2.5	1.4	0.5	0	1	1.7	2.2	2.9	3.4	4	4.6	5	5	5	5	5	
10	5	5	4.6	3.8	2	1.2	0.5	0	1	1.6	2.3	2.9	3.5	4	4.5	4.9	5	5	5	5	
11	5	4.9	4.5	3.1	1.9	1.1	0.4	0	1	1.6	2.4	3	3.5	4	4.5	4.9	5	5	5	5	
12	5	4.7	4.2	2.9	1.7	1	0.1	0	1	1.9	2.6	3.3	3.8	4.2	4.7	4.9	5	5	5	5	
13	5	4.7	4.2	2.5	1.5	0.7	0	0.5	1.2	2.1	3	3.8	4.4	4.7	4.9	5	5	5	5	5	
14	5	4.7	4	2.5	1.5	0.5	0	0.7	1.7	2.6	3.6	4.5	4.8	5	5	5	5	5	5	5	
15	5	4.7	4	2.3	1.3	0.5	0.5	1.2	2.3	3	4.5	4.9	5	5	5	5	5	5	5	5	
16	5	4.7	3.5	2.2	1.5	1.1	1.2	2	2.6	4	4.9	5	5	5	5	5	5	5	5	5	
17	5	4.7	3.5	2.1	1.8	1.8	2	2.6	3.6	4.8	5	5	5	5	5	5	5	5	5	5	
18	5	4.7	4	2.5	2.2	2.2	2.7	3.5	4.5	5	5	5	5	5	5	5	5	5	5	5	
19	5	4.6	4.2	3.1	3	3	3.5	4.5	4.9	5	5	5	5	5	5	5	5	5	5	5	
20	5	4.9	4.7	4.2	4	4	4.5	4.9	5	5	5	5	5	5	5	5	5	5	5	5	
21	5	5	4.9	4.7	4.7	4.7	4.9	5	5	5	5	5	5	5	5	5	5	5	5	5	
22	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
23	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
24	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
25	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
26	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
27	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
28	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
29	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
30	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	

Legend: Each cell is 85x110 ft
Concentrations are in mg/L

Dissolved Oxygen Grid
For Hill AFB Model

ENGINEERING-SCIENCE, INC.
Denver, Colorado

Nitrate (as N) Values used in initial setup of Hill Model, Fall of 1993.
(mg/L)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	(x-axis)
(y-axis) 1	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
2	5	5	5	5	5	4.5	4.5	5	5	5	5	5	5	5	5	5	5	5	5	5	
3	5	5	5	5	4.5	2	2	4.5	5	5	5	5	5	5	5	5	5	5	5	5	
4	5	5	5	5	3.5	0.8	1	3.5	4.8	5	5	5	5	5	5	5	5	5	5	5	
5	5	5	5	5	3.5	1	0.2	1	4.5	5	5	5	5	5	5	5	5	5	5	5	
6	5	5	5	5	4	1.5	0	1	3.5	5	5	5	5	5	5	5	5	5	5	5	
7	5	5	5	5	3.5	1.5	0	1.2	3.8	5	5	5	5	5	5	5	5	5	5	5	
8	5	5	5	4	3	1	0	1.5	4.5	5	5	5	5	5	5	5	5	5	5	5	
9	5	5	4	3.5	2	0.8	0	1.5	4	5	5	5	5	5	5	5	5	5	5	5	
10	4.9	4	3.5	3	1.6	0.6	0	0.8	2	4	4.5	4.7	4.7	4.7	4.7	4.9	5	5	5	5	
11	3.8	3.5	3.2	2.1	1.1	0.4	0	0.4	0.8	1.5	2	3	3	3	3	4	4.7	5	5	5	
12	3.6	3.3	2.9	2.2	0.9	0.4	0	0	0.4	0.6	0.8	1.3	2	2.2	2.5	2.9	4	5	5	5	
13	3.5	3.2	3	2.9	1.5	0.6	0.2	0	0.2	0.4	0.6	1.1	1.7	2.2	2.7	3.2	4.5	5	5	5	
14	3.5	3.4	3.2	4.2	3.5	1	0.6	0.1	0.1	0.5	0.8	1.3	1.9	2.5	3.2	4.5	5	5	5	5	
15	3.7	3.7	3.9	4.9	4.9	3.5	1	0.2	0.2	0.7	1.2	1.9	2.5	3.3	4.5	5	5	5	5	5	
16	3.9	4.5	4.7	5	5	4	1.5	0.2	0.6	1.4	2	3	3.6	4.5	5	5	5	5	5	5	
17	5	5	5	5	4	1.5	0.5	0.7	1.5	2.5	3.2	4	4.6	5	5	5	5	5	5	5	
18	5	5	5	4	1	0.8	1	2.5	3	3.6	5	5	5	5	5	5	5	5	5	5	
19	5	5	5	5	4.8	4.5	4.5	4.5	4.7	4.9	5	5	5	5	5	5	5	5	5	5	
20	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
21	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
22	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
23	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
24	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
25	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
26	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
27	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
28	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
29	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
30	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	

Legend: **Each cell is 85x110 ft**
Concentrations are in mg/L

Nitrate (as N) Grid
For Hill AFB Model

ENGINEERING-SCIENCE, INC.
Denver, Colorado

	Nitrate values (as nitrate ion) used in initial setup of Hill model, Fall 1993																				
	(mg/L)																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	(x-axis)
(y-axis) 1	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	
2	14	14	14	14	14	13	13	14	14	14	14	14	14	14	14	14	14	14	14	14	
3	14	14	14	14	13	5.8	5.8	13	14	14	14	14	14	14	14	14	14	14	14	14	
4	14	14	14	14	10	2.3	2.9	10	14	14	14	14	14	14	14	14	14	14	14	14	
5	14	14	14	14	10	2.9	0.6	2.9	13	14	14	14	14	14	14	14	14	14	14	14	
6	14	14	14	14	12	4.3	0	2.9	10	14	14	14	14	14	14	14	14	14	14	14	
7	14	14	14	14	10	4.3	0	3.5	11	14	14	14	14	14	14	14	14	14	14	14	
8	14	14	14	12	8.6	2.9	0	4.3	13	14	14	14	14	14	14	14	14	14	14	14	
9	14	14	12	10	5.8	2.3	0	4.3	12	14	14	14	14	14	14	14	14	14	14	14	
10	14	12	10	8.6	4.6	1.7	0	2.3	5.8	12	13	14	14	14	14	14	14	14	14	14	
11	11	10	9.2	6	3.2	1.2	0	1.2	2.3	4.3	5.8	8.6	8.6	8.6	8.6	12	14	14	14	14	
12	10	9.5	8.3	6.3	2.6	1.2	0	0	1.2	1.7	2.3	3.7	5.8	6.3	7.2	8.3	12	14	14	14	
13	10	9.2	8.6	8.3	4.3	1.7	0.6	0	0.6	1.2	1.7	3.2	4.9	6.3	7.8	9.2	13	14	14	14	
14	10	9.8	9.2	12	10	2.9	1.7	0.3	0.3	1.4	2.3	3.7	5.5	7.2	9.2	13	14	14	14	14	
15	11	11	11	14	14	10	2.9	0.6	0.6	2	3.5	5.5	7.2	9.5	13	14	14	14	14	14	
16	11	13	14	14	14	12	4.3	0.6	1.7	4	5.8	8.6	10	13	14	14	14	14	14	14	
17	14	14	14	14	12	4.3	1.4	2	4.3	7.2	9.2	12	13	14	14	14	14	14	14	14	
18	14	14	14	12	2.9	2.3	2.9	7.2	8.6	10	14	14	14	14	14	14	14	14	14	14	
19	14	14	14	14	14	13	13	13	14	14	14	14	14	14	14	14	14	14	14	14	
20	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	
21	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	
22	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	
23	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	
24	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	
25	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	
26	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	
27	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	
28	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	
29	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	
30	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	

Legend: **Each cell is 85x110 ft**
Concentrations are in mg/L

Nitrate (as NO_3^-) Grid
For Hill AFB Model

ENGINEERING-SCIENCE, INC.
Denver, Colorado

	Combined concentrations of oxygen and nitrate used for setup of Hill model, Fall 1993.																				
	(mg/L)																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	(x-axis)
(y-axis) 1	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	
2	19	19	19	19	19	18	16	17	19	19	19	19	19	19	19	19	19	19	19	19	
3	19	19	19	19	18	9.9	6.8	14	17	19	19	19	19	19	19	19	19	19	19	19	
4	19	19	19	19	15	5.4	5.9	11	16	17	18	19	19	19	19	19	19	19	19	19	
5	19	19	19	19	15	5.9	0.7	4	14	16	17	18	19	19	19	19	19	19	19	19	
6	19	19	19	19	16	6.8	0.5	3	10	15	16	17	18	19	19	19	19	19	19	19	
7	19	19	19	19	14	6.3	0.5	3.5	11	16	16	17	18	19	19	19	19	19	19	19	
8	19	19	19	16	12	4.6	0.5	4.3	14	16	17	17	18	19	19	19	19	19	19	19	
9	19	19	16	14	8.3	3.7	0.5	4.3	13	16	17	17	18	18	19	19	19	19	19	19	
10	19	17	15	12	6.6	2.9	0.5	2.3	6.8	13	15	16	17	18	18	19	19	19	19	19	
11	16	15	14	9.1	5.1	2.3	0.4	1.2	3.3	5.9	8.2	12	12	13	13	16	19	19	19	19	
12	15	14	13	9.2	4.3	2.2	0.1	0	2.2	3.6	4.9	7	9.6	11	12	13	17	19	19	19	
13	15	14	13	11	5.8	2.4	0.6	0.5	1.8	3.3	4.7	7	9.3	11	13	14	18	19	19	19	
14	15	14	13	15	12	3.4	1.7	1	2	4	5.9	8.2	10	12	14	18	19	19	19	19	
15	16	15	15	16	15	11	3.4	1.8	2.9	5	8	10	12	14	18	19	19	19	19	19	
16	16	18	17	17	16	13	5.5	2.6	4.3	8	11	14	15	18	19	19	19	19	19	19	
17	19	19	18	16	13	6.1	3.4	4.6	7.9	12	14	17	18	19	19	19	19	19	19	19	
18	19	19	18	14	5.1	4.5	5.6	11	13	15	19	19	19	19	19	19	19	19	19	19	
19	19	19	19	17	17	16	16	17	18	19	19	19	19	19	19	19	19	19	19	19	
20	19	19	19	19	18	18	19	19	19	19	19	19	19	19	19	19	19	19	19	19	
21	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	
22	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	
23	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	
24	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	
25	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	
26	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	
27	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	
28	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	
29	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	
30	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	

Legend: Each cell is 85x110 ft
Concentrations are in mg/L

Combined Oxygen and Nitrate (as NO_3^-) Concentrations For Hill AFB Model

ENGINEERING-SCIENCE, INC.
Denver, Colorado

Oxygen concentrations used for initial setup of Hill model, Fall 1993

(mg/L)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20 (x-axis)
(y-axis) 1	5	5	5	5	5	5	4.7	4.9	5	5	5	5	5	5	5	5	5	5	5	5
2	5	5	5	5	5	4.8	3	3	4.5	5	5	5	5	5	5	5	5	5	5	5
3	5	5	5	5	5	4.1	1	1	3	4.5	5	5	5	5	5	5	5	5	5	5
4	5	5	5	5	4.8	3.1	3	1	2	3	4	4.7	5	5	5	5	5	5	5	5
5	5	5	5	5	4.5	3	0.1	1.1	1.5	2	2.9	3.6	4.7	5	5	5	5	5	5	5
6	5	5	5	4.9	4.2	2.5	0.5	0.1	0.3	1	2	3	4	4.7	5	5	5	5	5	5
7	5	5	5	4.7	4	2	0.5	0	0.5	1.2	2	3	3.9	4.5	5	5	5	5	5	5
8	5	5	5	4.5	3.2	1.7	0.5	0	1	1.5	2.2	2.9	3.6	4.2	4.9	5	5	5	5	5
9	5	5	4.7	4.2	2.5	1.4	0.5	0	1	1.7	2.2	2.9	3.4	4	4.6	5	5	5	5	5
10	5	5	4.6	3.8	2	1.2	0.5	0	1	1.6	2.3	2.9	3.5	4	4.5	4.9	5	5	5	5
11	5	4.9	4.5	3.1	1.9	1.1	0.4	0	1	1.6	2.4	3	3.5	4	4.5	4.9	5	5	5	5
12	5	4.7	4.2	2.9	1.7	1	0.1	0	1	1.9	2.6	3.3	3.8	4.2	4.7	4.9	5	5	5	5
13	5	4.7	4.2	2.5	1.5	0.7	0	0.5	1.2	2.1	3	3.8	4.4	4.7	4.9	5	5	5	5	5
14	5	4.7	4	2.5	1.5	0.5	0	0.7	1.7	2.6	3.6	4.5	4.8	5	5	5	5	5	5	5
15	5	4.7	4	2.3	1.3	0.5	0.5	1.2	2.3	3	4.5	4.9	5	5	5	5	5	5	5	5
16	5	4.7	3.5	2.2	1.5	1.1	1.2	2	2.6	4	4.9	5	5	5	5	5	5	5	5	5
17	5	4.7	3.5	2.1	1.8	1.8	2	2.6	3.6	4.8	5	5	5	5	5	5	5	5	5	5
18	5	4.7	4	2.5	2.2	2.2	2.7	3.5	4.5	5	5	5	5	5	5	5	5	5	5	5
19	5	4.6	4.2	3.1	3	3	3.5	4.5	4.9	5	5	5	5	5	5	5	5	5	5	5
20	5	4.9	4.7	4.2	4	4	4.5	4.9	5	5	5	5	5	5	5	5	5	5	5	5
21	5	5	4.9	4.7	4.7	4.7	4.9	5	5	5	5	5	5	5	5	5	5	5	5	5
22	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
23	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
24	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
25	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
26	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
27	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
28	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
29	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
30	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

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Nitrate (as N) Values used in initial setup of Hill Model, Fall of 1993.

(mg/L)

(y-axis) \ (x-axis)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
2	5	5	5	5	5	4.5	4.5	5	5	5	5	5	5	5	5	5	5	5	5	5
3	5	5	5	5	4.5	2	2	4.5	5	5	5	5	5	5	5	5	5	5	5	5
4	5	5	5	5	3.5	0.8	1	3.5	4.8	5	5	5	5	5	5	5	5	5	5	5
5	5	5	5	5	3.5	1	0.2	1	4.5	5	5	5	5	5	5	5	5	5	5	5
6	5	5	5	5	4	1.5	0	1	3.5	5	5	5	5	5	5	5	5	5	5	5
7	5	5	5	5	3.5	1.5	0	1.2	3.8	5	5	5	5	5	5	5	5	5	5	5
8	5	5	5	4	3	1	0	1.5	4.5	5	5	5	5	5	5	5	5	5	5	5
9	5	5	4	3.5	2	0.8	0	1.5	4	5	5	5	5	5	5	5	5	5	5	5
10	4.9	4	3.5	3	1.6	0.6	0	0.8	2	4	4.5	4.7	4.7	4.7	4.7	4.9	5	5	5	5
11	3.8	3.5	3.2	2.1	1.1	0.4	0	0.4	0.8	1.5	2	3	3	3	3	4	4.7	5	5	5
12	3.6	3.3	2.9	2.2	0.9	0.4	0	0	0.4	0.6	0.8	1.3	2	2.2	2.5	2.9	4	5	5	5
13	3.5	3.2	3	2.9	1.5	0.6	0.2	0	0.2	0.4	0.6	1.1	1.7	2.2	2.7	3.2	4.5	5	5	5
14	3.5	3.4	3.2	4.2	3.5	1	0.6	0.1	0.1	0.5	0.8	1.3	1.9	2.5	3.2	4.5	5	5	5	5
15	3.7	3.7	3.9	4.9	4.9	3.5	1	0.2	0.2	0.7	1.2	1.9	2.5	3.3	4.5	5	5	5	5	5
16	3.9	4.5	4.7	5	5	4	1.5	0.2	0.6	1.4	2	3	3.6	4.5	5	5	5	5	5	5
17	5	5	5	5	4	1.5	0.5	0.7	1.5	2.5	3.2	4	4.6	5	5	5	5	5	5	5
18	5	5	5	4	1	0.8	1	2.5	3	3.6	5	5	5	5	5	5	5	5	5	5
19	5	5	5	5	4.8	4.5	4.5	4.5	4.7	4.9	5	5	5	5	5	5	5	5	5	5
20	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
21	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
22	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
23	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
24	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
25	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
26	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
27	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
28	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
29	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
30	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

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Nitrate values (as nitrate ion) used in initial setup of Hill model, Fall 1993

(mg/L)

(y-axis) \ (x-axis)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
2	14	14	14	14	14	13	13	14	14	14	14	14	14	14	14	14	14	14	14	14
3	14	14	14	14	13	5.8	5.8	13	14	14	14	14	14	14	14	14	14	14	14	14
4	14	14	14	14	10	2.3	2.9	10	14	14	14	14	14	14	14	14	14	14	14	14
5	14	14	14	14	10	2.9	0.6	2.9	13	14	14	14	14	14	14	14	14	14	14	14
6	14	14	14	14	12	4.3	0	2.9	10	14	14	14	14	14	14	14	14	14	14	14
7	14	14	14	14	10	4.3	0	3.5	11	14	14	14	14	14	14	14	14	14	14	14
8	14	14	14	12	8.6	2.9	0	4.3	13	14	14	14	14	14	14	14	14	14	14	14
9	14	14	12	10	5.8	2.3	0	4.3	12	14	14	14	14	14	14	14	14	14	14	14
10	14	12	10	8.6	4.6	1.7	0	2.3	5.8	12	13	14	14	14	14	14	14	14	14	14
11	11	10	9.2	6	3.2	1.2	0	1.2	2.3	4.3	5.8	8.6	8.6	8.6	8.6	12	14	14	14	14
12	10	9.5	8.3	6.3	2.6	1.2	0	0	1.2	1.7	2.3	3.7	5.8	6.3	7.2	8.3	12	14	14	14
13	10	9.2	8.6	8.3	4.3	1.7	0.6	0	0.6	1.2	1.7	3.2	4.9	6.3	7.8	9.2	13	14	14	14
14	10	9.8	9.2	12	10	2.9	1.7	0.3	0.3	1.4	2.3	3.7	5.5	7.2	9.2	13	14	14	14	14
15	11	11	11	14	14	10	2.9	0.6	0.6	2	3.5	5.5	7.2	9.5	13	14	14	14	14	14
16	11	13	14	14	14	12	4.3	0.6	1.7	4	5.8	8.6	10	13	14	14	14	14	14	14
17	14	14	14	14	12	4.3	1.4	2	4.3	7.2	9.2	12	13	14	14	14	14	14	14	14
18	14	14	14	12	2.9	2.3	2.9	7.2	8.6	10	14	14	14	14	14	14	14	14	14	14
19	14	14	14	14	14	13	13	13	14	14	14	14	14	14	14	14	14	14	14	14
20	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
21	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
22	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
23	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
24	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
25	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
26	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
27	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
28	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
29	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
30	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14

Combined concentrations of oxygen and nitrate used for setup of Hill model, Fall 1993.

(mg/L)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	(x-axis)
(y-axis)	1	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	
	2	19	19	19	19	19	18	16	17	19	19	19	19	19	19	19	19	19	19	19	19	
	3	19	19	19	19	18	9.9	6.8	14	17	19	19	19	19	19	19	19	19	19	19	19	
	4	19	19	19	19	15	5.4	5.9	11	16	17	18	19	19	19	19	19	19	19	19	19	
	5	19	19	19	19	15	5.9	0.7	4	14	16	17	18	19	19	19	19	19	19	19	19	
	6	19	19	19	19	16	6.8	0.5	3	10	15	16	17	18	19	19	19	19	19	19	19	
	7	19	19	19	19	14	6.3	0.5	3.5	11	16	16	17	18	19	19	19	19	19	19	19	
	8	19	19	19	16	12	4.6	0.5	4.3	14	16	17	17	18	19	19	19	19	19	19	19	
	9	19	19	16	14	8.3	3.7	0.5	4.3	13	16	17	17	18	18	19	19	19	19	19	19	
	10	19	17	15	12	6.6	2.9	0.5	2.3	6.8	13	15	16	17	18	18	19	19	19	19	19	
	11	16	15	14	9.1	5.1	2.3	0.4	1.2	3.3	5.9	8.2	12	12	13	13	16	19	19	19	19	
	12	15	14	13	9.2	4.3	2.2	0.1	0	2.2	3.6	4.9	7	9.6	11	12	13	17	19	19	19	
	13	15	14	13	11	5.8	2.4	0.6	0.5	1.8	3.3	4.7	7	9.3	11	13	14	18	19	19	19	
	14	15	14	13	15	12	3.4	1.7	1	2	4	5.9	8.2	10	12	14	18	19	19	19	19	
	15	16	15	15	16	15	11	3.4	1.8	2.9	5	8	10	12	14	18	19	19	19	19	19	
	16	16	18	17	17	16	13	5.5	2.6	4.3	8	11	14	15	18	19	19	19	19	19	19	
	17	19	19	18	16	13	6.1	3.4	4.6	7.9	12	14	17	18	19	19	19	19	19	19	19	
	18	19	19	18	14	5.1	4.5	5.6	11	13	15	19	19	19	19	19	19	19	19	19	19	
	19	19	19	19	17	17	16	16	17	18	19	19	19	19	19	19	19	19	19	19	19	
	20	19	19	19	19	18	18	19	19	19	19	19	19	19	19	19	19	19	19	19	19	
	21	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	
	22	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	
	23	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	
	24	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	
	25	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	
	26	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	
	27	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	
	28	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	
	29	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	
	30	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	

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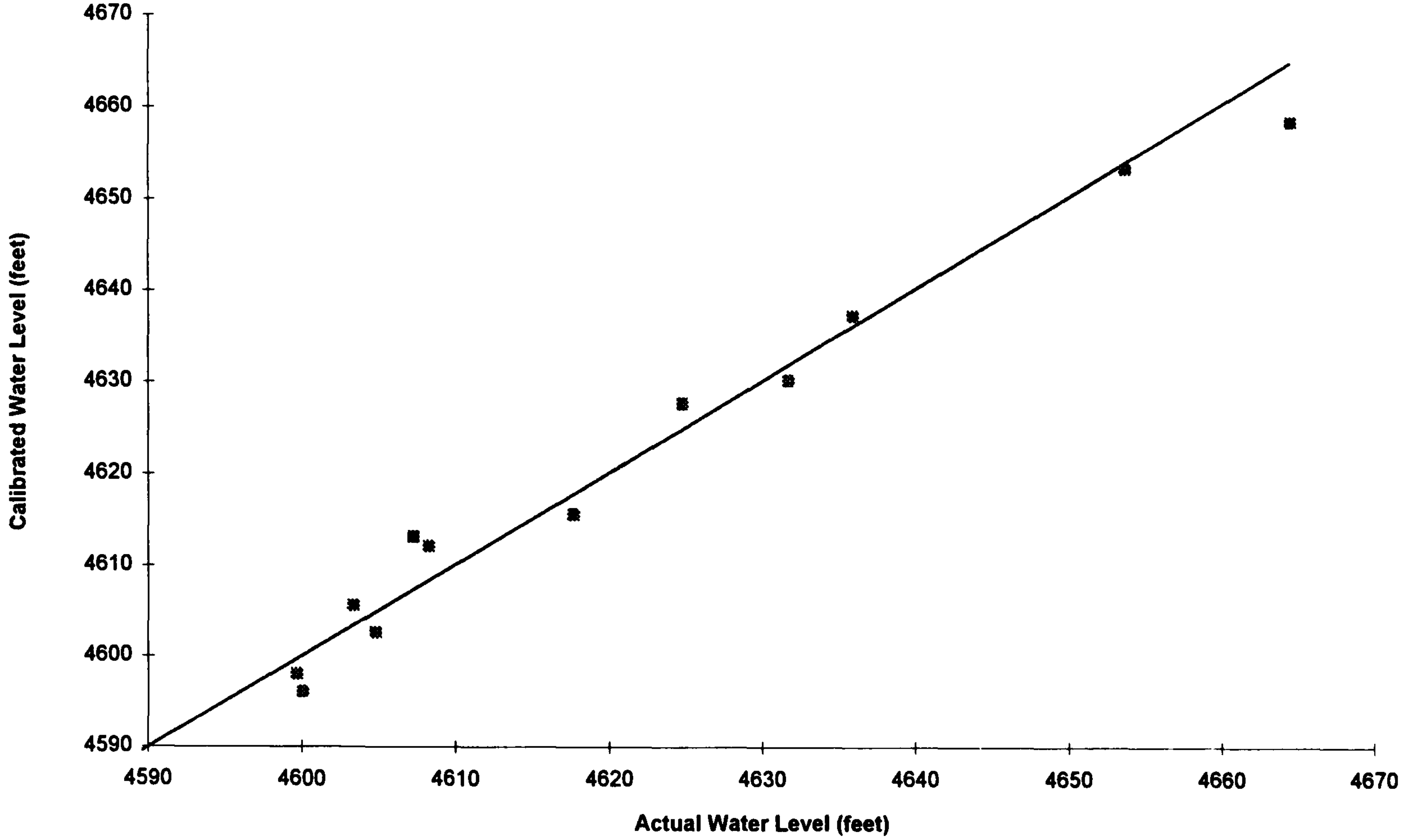
Hill AFB Groundwater Model
Calibration Error Plot



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Ground Water Model Calibration Error

Location	Actual Water Level	Calibrated Water Level	derivation from mean h_m-h_s	abs(h_m-h_s)	$(h_m-h_s)^2$
EPA82I	4664.53	4658.0	-6.53	6.53	42.6409
EPA82D	4631.70	4630.0	-1.7	1.7	2.89
EPA82B	4608.28	4612.0	3.72	3.72	13.8384
EPA82C	4603.37	4605.5	2.13	2.13	4.5369
EPA82F	4600.06	4596.0	-4.06	4.06	16.4836
EPA82E	4595.21	4587.5	-7.71	7.71	59.4441
EPA92H	4599.66	4598.0	-1.66	1.66	2.7556
CPT-41	4635.89	4637.0	1.11	1.11	1.2321
CPT-23	4617.65	4615.5	-2.15	2.15	4.6225
CPT-21	4624.80	4627.5	2.7	2.7	7.29
CPT-15	4607.29	4613.0	5.71	5.71	32.6041
CPT-31	4604.83	4602.5	-2.33	2.33	5.4289
MW12	4653.73	4653.0	-0.73	0.73	0.5329
Total:	60047	60035.5	-11.5	42.24	194.3
			ME	-0.884615	
			MAE=	3.2492308	
			RMS=	3.8660256	

hm=calibrated water level

hs=actual water level

ME=$1/n*\Sigma(h_m-h_s)$

MAE=$1/n*\Sigma|(h_m-h_s)|$

RMS=$(1/n*\Sigma(h_m-h_s)^2)^{0.5}$

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ESTIMATION OF LONGITUDINAL DISPERSIVITY

Assumptions:

A. Plume migration is sufficiently aligned along the longitudinal axis of the grid that a longitudinal moment may be calculated.

B. Longitudinal dispersivity is 1/10 of the distance from the source of contamination to the center of contamination.

From the attached figure, an estimate for the center of mass will be taken by calculating the longitudinal moment around cell 9,2 which is near the source of contamination:

Row	Mass	Distance From cell (2,9)	Mass x Dist. From Cell 9,2
Row 3	4500 ug/L	110	495000
Row 4	25660 ug/L	220	5645200
Row 5	29950 ug/L	330	9883500
Row 6	29150 ug/L	440	12826000
Row 7	26450 ug/L	550	14547500
Row 8	22850 ug/L	660	15081000
Row 9	18700 ug/L	770	14399000
Row 10	16600 ug/L	880	14608000
Row 11	17000 ug/L	990	16830000
Row 12	17625 ug/L	1100	19387500
Row 13	15100 ug/L	1210	18271000
Row 14	2950 ug/L	1320	3894000
Total	226535 ug/L		145867700

The estimated longitudinal centroid of the plume is:

145867700/226535 ug/L = 643.9 ft (from the center of cell 2,9)

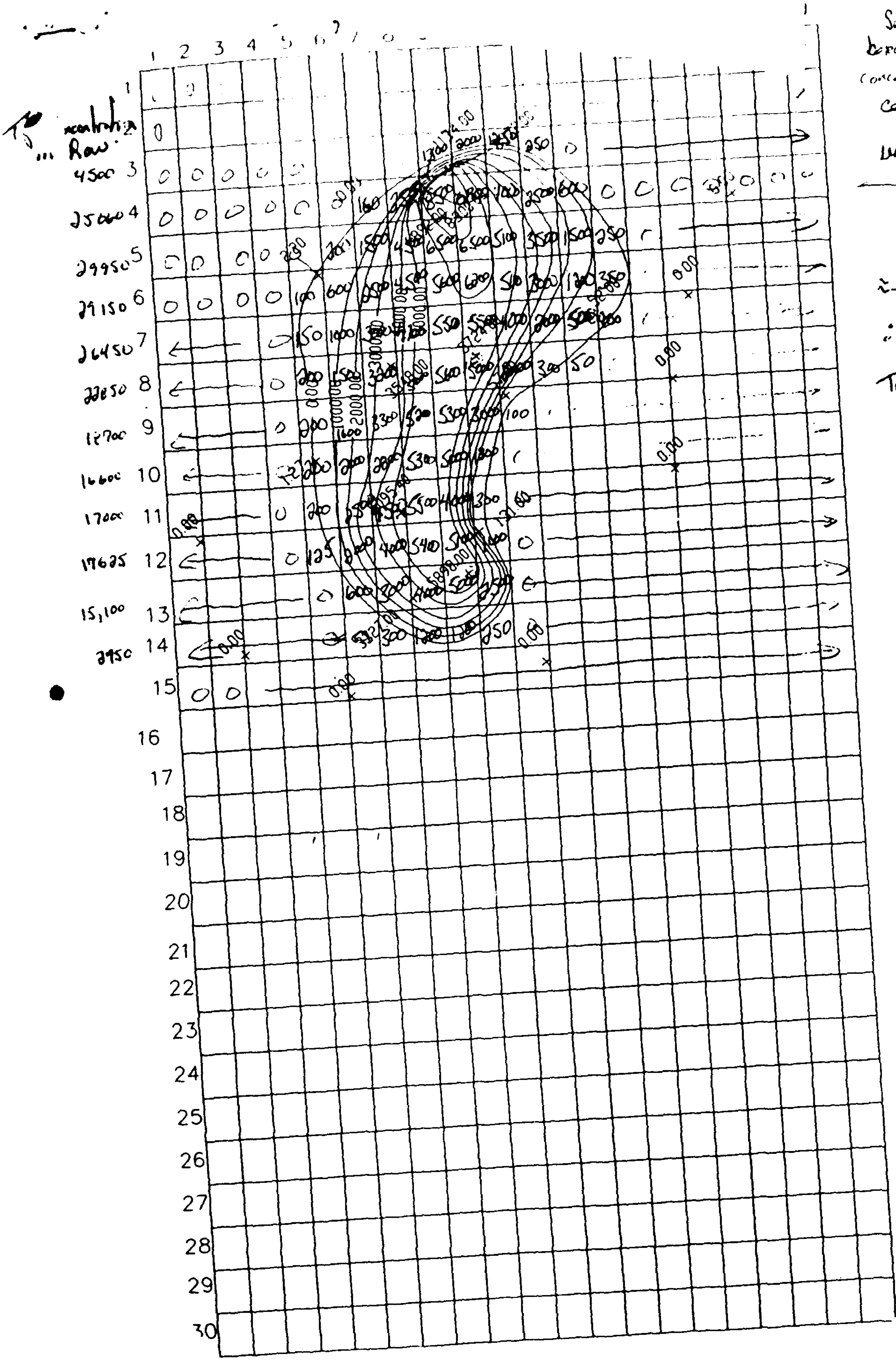
The estimated source of contamination is at cell 3,9. Therefore, the estimated distance between the source of contamination and the longitudinal center of mass is:

643.9 ft (centroid) - 110 ft (distance from 2,9 to 3,9) = 533.9 ft

From assumption B, the estimated longitudinal dispersivity is 1/10 of the distance between the source of contamination and the longitudinal center of mass and is:

Estimated Long. Dispersivity = 533.9 x 0.1 = 53.39 or 53.4 ft.

m:\45002\report\tables\dispesti.doc



Selected cell concentration based on an average concentration over the cell

units in µg/L

~~[illegible]~~

~~[illegible] 1.25~~

Traverse = 1.25

APPENDIX E

BIOPLUME II MODEL OUTPUT